

102695

TECHNICAL SPECIFICATIONS FOR THE
DISMANTLEMENT, EXCAVATION, REMEDIATION,
AND RESTORATION OF PROPERTIES AT THE
AUSTIN AVENUE RADIATION SITE

DELAWARE COUNTY, PENNSYLVANIA

VOLUME 2

DIVISIONS 2 THROUGH 16

Received 2/8/94
by V. Janosik RPM

AR302614

SECTION 02050

DISMANTLING

PART 1 GENERAL

1.1 REFERENCES (Not Applicable)

1.2 GENERAL REQUIREMENTS

The work includes dismantling, salvage of identified nonradioactive items and materials, and removal of resulting rubbish and debris. Rubbish and nonhazardous debris shall be removed from the site as soon as is practicle unless otherwise directed, to avoid accumulation at the dismantling site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified. The Contractor has no title to real property at the completion of this contract.

1.3 SUBMITTALS

Work Plan

The procedures as proposed for the accomplishment of the work. The procedures shall provide for timely disconnection of utility services, safe conduct of the work, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, and coordination with other work in progress. The procedures shall include detailed descriptions of the methods and equipment to be used for each operation, and the sequence of operations as required for each property.

1.4 DUST CONTROL

The amount of dust resulting from dismantling shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as potential cross contamination, ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Existing Property

Before beginning any dismantling work, the Contractor shall carefully survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to avoid damage to existing items to remain in place, or to be reused, and any damaged items shall be repaired or replaced as approved by the Contracting Officer's Representative (COR) at the cost of the Contractor. The Contractor shall carefully coordinate the work of this section with all other work and shall construct and maintain shoring, bracing and supports, as required. The Contractor shall ensure the structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or dismantling work performed under this contract.

1.5.2 Protection From the Weather

The interior of buildings to remain and salvageable materials and equipment shall be protected from the weather at all times.

1.5.3 Protection of Trees, Shrubbery, and Other Landscaping Planting Material

Trees, shrubbery, and other planting material within the project site which might be damaged during dismantling and which are indicated to be left in place shall be protected by a 6-foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees, shrubbery, etc. Any plant designated to remain that is damaged during the work under this contract shall be replaced in kind (nursery stock) or as approved by the Contracting Officers Representative (COR).

1.5.4 Environmental Protection

The work shall comply with the requirements of Section 01560, ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed to bottom of foundation walls. Basement slabs shall be removed or broken up to permit drainage. Sidewalks, curbs, gutters and street light bases shall be removed as indicated. All removed materials shall be surveyed and characterized as defined in Specification 01927, SURVEYS FOR CONTAMINATION.

3.2 UTILITIES

Disconnections of utility services, with related meters and equipment, are to be coordinated with provider of utility service and terminated in an appropriate manner. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section 02201, EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS.

3.4 DISPOSITION OF MATERIAL

3.4.1 Salvageable Items and Materials (Deleted)

3.4.1.1 Material Salvaged for the Contractor (Deleted)

Title to materials and equipment to be dismantled, excepting salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Contractor will be responsible for the condition, loss, or damage to such property after notice to proceed.

3.4.1.2 Items Salvaged for other than the Contractor

Salvaged items, if applicable, to remain the property of the EPA or former property owner or occupant shall be removed in a manner to prevent damage and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

3.4.1.3 Historical Items

Historical items that are not contaminated or can be decontaminated shall be removed in a manner to prevent damage. The following historical items shall be delivered to the PA for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Materials

Concrete, masonry, and other materials, except concrete permitted to remain in place, shall be disposed of in the off-site disposal site(s) as determined by the Contractor, see Specification Section 01928, HAZARDOUS WASTE CHARACTERIZATION, DECONTAMINATION, AND DISPOSAL.

3.5 CLEAN-UP

Debris and rubbish shall be removed from basements and similar excavations. Local regulations regarding onsite staging, hauling and disposal shall apply.

END OF SECTION

SECTION 02080

RADIOACTIVE MATERIALS, LEAD, AND ASBESTOS REMEDIATION

PART 1 GENERAL

1.1 SCOPE OF WORK

The work covered by this Section includes furnishing all required plant, labor, equipment, materials, and transportation necessary for the proper and safe removal, handling, and disposal of radioactive material, asbestos-containing materials (ACM), and lead-containing materials during this project. Work shall be performed in accordance with all applicable federal, state and local regulations, including but not limited to the regulations specified in this Section and as indicated on accompanying Drawings.

1.1.1 Radium 226 and thorium 230 are the radioactive materials present in the twenty designated site buildings. Based on existing site data, there is approximately five times as much thorium 230 present than radium 226. The radioactive material, lead, and asbestos-related work for this project includes the following:

1.1.2 Additional Radioactive Material, Lead-Containing Materials, and/or Asbestos-Containing Materials (ACM)

a. Work areas known to contain or not to contain radioactive materials and/or ACM have been identified in the Contract Documents. Additional surveys may be required to be performed by the Contractor to further delineate the extent of these materials. For any other areas suspected of containing radioactive materials and/or ACM which would be impacted by the work involved and are not identified on the Contract Documents, the Contractor shall notify the Contracting Officer. Any additional areas that have been identified to contain radioactive materials and/or ACM and that have been approved by the Contracting Officer for removal shall be removed by the Contractor and will be paid for by an equitable adjustment to the contract sum, in accordance with Contract Documents.

b. Lead and lead-containing materials may be present in the site structures. No prior surveys for lead identification or delineation have been conducted. As part of this Contract, there is to be no separate removal or remediation of lead-containing materials. This material will be included as and be handled as general demolition debris.

1.2 CODES, PERMITS, AND STANDARDS

The Contractor shall comply with all applicable federal, state, and local laws, ordinances, codes, rules, and regulations. Before starting the work, the Contractor shall examine the Technical Specifications and Drawings for compliance with codes and regulations applicable to the work and shall immediately report any discrepancy to the Engineer.

1.2.1 Federal and State Regulations, Codes, and Standards: The current issue of each document shall govern. Where conflict among requirements or with these specifications exists, the more stringent requirements shall apply. The Contractor shall have one copy of the following regulations governing the work available for review at the site at all times:

1.2.1.1 Code of Federal Regulations (CFR):

10 CFR Part 19	Notices, Instructions, and Reports to Workers; Inspections
10 CFR Part 20	Standards for Protection Against Radiation
10 CFR Part 61	Licensing Requirements for Land Disposal of Radioactive Waste
10 CFR Part 71	Packaging of Radioactive Material for Transport and Transportation of Radioactive Material under Certain Conditions
29 CFR Parts 1910, 1926	U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA) Standards
40 CFR Part 260	Hazardous Waste Management System General
40 CFR Part 261	Identification and Listing of Hazardous Wastes
40 CFR Part 262	Standards Applicable to Transporters of Hazardous Waste
40 CFR Part 61	National Emission Standards for Hazardous Air Pollutants
40 CFR Part 141	National Primary Drinking Water Regulations
49 CFR Parts 170-199	Department of Transportation Hazardous Material Regulations

1.2.1.2 Regulatory Guides

In addition to regulations that carry the force of law, regulatory bodies such as the NRC and EPA prepare regulatory guides that, among other things, suggest agency-approved methodology and solutions to problems. While compliance with them is not a legal requirement, they generally provide the most effective method of obtaining approval for a particular course of action.

The NRC Regulatory Guides applicable to this project are as follows:

	<u>NRC Regulatory Guide Number</u>	<u>Title</u>
A.	1.8	Personnel Qualification and Training
B.	1.86	Termination of Operating Licenses for Nuclear Operators
C.	1.16	Reporting of Operating Information
D.	8.2	Guide for Administrative Practices in Radiation Monitoring
E.	8.3	Film Badge Performance Criteria
F.	8.4	Direct-Reading and Indirect-Reading Pocket Dosimeters
G.	8.6	Standard Test Procedures for Geiger-Muller Counters
H.	8.7	Occupational Radiation Exposure Records Systems
I.	8.9	Acceptable Concepts, Models, Equations, and Assumption for a Bioassay Program
J.	8.10	Operating Philosophy for Maintaining Occupational Radiation Exposure as Low as Reasonably Achievable
K.	8.15	Acceptable Programs for Respiratory Protection

1.2.2 Manufacturer's Standards: The following Manufacturer's Standards shall apply, as referenced:

1.2.2.1 American National Standards Institute (ANSI) Publications:

ANSI N13.13	Control of Radioactive Surface Contamination of Material, Equipment, and Facilities to be Released for Uncontrolled Use (Draft)
ANSI Z86.1	Commodity Specification for Air
ANSI Z88.2 1980	Practices for Respiratory Protection
ANSI N13.1	Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities
ANSI N323- 1977	Radiation Test and Calibration Protection Instrumentation
ANSI Z9.2-79	Fundamentals Governing the Design and Operation of Local Exhaust Systems

1.2.2.1 Underwriters Laboratories Inc. (UL) Publications:

586-77	Test Performance of High Efficiency Particulate Air Filter Units
586-85	Standard for High-Efficiency Particulate Air Filter Units
467	Grounding and Bonding Equipment

1.2.2.3 American Society for Testing and Materials (ASTM) Publication:

D1331-56	Surface and Interfacial Tension of Solutions of Surface-Active Agents
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1.2.2.4 National Fire Protection Association (NFPA) Publication

70-1993	National Electrical Code (NEC)
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1.2.3 Certifications and Notifications: The Contractor shall be responsible for obtaining necessary certifications of personnel in conjunction with radioactive material and asbestos removal, hauling, and disposition and shall provide timely notification of such actions as may be required by federal, state, regional, and local authorities. Fees and/or charges for these certifications or notifications shall be paid by the Contractor.

1.3 TERMINOLOGY

The following commonly-used terms are defined in the context of these specifications:

1.3.1 Abatement: Procedures to control or decrease radioactive particle release from materials and fiber release from asbestos-containing building materials.

1.3.2 Asbestos-Containing Material (ACM): Any material or product which contains more than 1 percent asbestos.

1.3.3 Aggressive Sampling: Air monitoring samples collected while a leaf blower, fans, or other such devices are used to generate air turbulence within the work area.

1.3.4 Air Filtration Device (AFD): A portable local exhaust system equipped with HEPA filtration, capable of maintaining a constant low velocity air flow into contaminated areas from adjacent, uncontaminated areas and capable of maintaining a negative air pressure with respect to the adjacent, uncontaminated areas.

1.3.5 Air Lock: A system for permitting ingress or egress to the work area while permitting minimal air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways placed a minimum of three feet apart.

1.3.6 Air Monitoring: The process of measuring the radioactive particulate and fiber content of a specific volume of air in a stated period of time. Personal air sampling results shall be calculated to reflect the employee's eight-hour time weighted average (TWA) exposure. Area sampling results are reported directly, without calculating the TWA.

1.3.7 Amended Water: Water to which a surfactant has been added.

1.3.8 Asbestos Removal Encapsulant: A chemical solution used in place of amended water during asbestos removal to penetrate, bind, and encapsulate the asbestos-containing material.

1.3.9 Authorized Visitor: The EPA or the EPA's representatives or representatives of any regulatory or other agency having jurisdiction over the project.

1.3.10 Competent Asbestos Person: Definition and responsibilities as set down in 29 CFR 1926.58(b) and as outlined herein.

1.3.11 Curtained Doorway: A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms.

1.3.12 Decontamination Enclosure System: A series of connected rooms for the decontamination of workers (a Personnel Decontamination Enclosure System) or of materials and equipment (Equipment Decontamination Enclosure System).

1.3.13 Differential Air Pressure Recording Device: A device capable of producing a continual strip record, in increments of 0.001 inches of water of the pressure differential between the containment area (work area) and the ambient air pressure.

1.3.14 Equipment Decontamination Enclosure System: A decontamination system for waste materials and equipment, typically consisting of a designated area of the work area, a washroom, and a holding area, with an air lock between any two adjacent rooms and a curtained doorway between the holding area and the non-work area. Not to be used for personnel entry/exit.

1.3.15 Encapsulant (Sealant): A liquid material which can be applied to ACM and which controls the possible release of asbestos fibers from the material, either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).

1.3.16 Encapsulation: Application of an encapsulant to asbestos-containing building materials to control the possible release of asbestos fibers into the ambient air.

1.3.17 Enclosure: Procedures necessary to completely enclose ACM behind air-tight, impermeable, permanent barriers.

1.3.18 Engineer: The EPA's agent (USACE) who is authorized to exercise general administration and supervision of the work.

1.3.19 Fixed Object: A unit of equipment or furniture in the work area which cannot be removed from the work area.

1.3.20 Friable: Any material which, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure.

1.3.21 Full Facepiece High Efficiency Respirator (FFHER): A respirator which covers the wearer's entire face from the hairline to below the chin and which is equipped with a HEPA filter.

1.3.22 Glovebag Technique: A method of limited application for removing small amounts of friable ACM from HVAC ducts, short piping runs, valves, joints, elbows, and other non-planar surfaces. The glovebag assembly is a manufactured or fabricated device typically constructed of 6-mil transparent plastic with two inwardly projecting, long-sleeved rubber gloves, one inwardly projecting waterwand sleeve, an internal tool pouch, and an attached, labeled receptacle for asbestos waste. The glovebag is constructed and

installed in such a manner that it surrounds the object or area to be decontaminated and contains all asbestos fibers released during the removal process. All workers who are permitted to use the glovebag technique must be highly trained, experienced, and skilled in this method.

1.3.23 Half Mask High Efficiency Respirator (HMHER): A respirator which covers one-half of the wearer's face, from the bridge of the nose to below the chin, and is equipped with HEPA filters.

1.3.24 HEPA Filter: A high efficiency particulate air (HEPA) filter capable of trapping and retaining 99.97 percent of the fibers of 0.3 micrometer or larger in diameter.

1.3.25 HEPA Vacuum Equipment: High efficiency particulate air (HEPA) filtered vacuuming equipment having a UL 586 filter system capable of collecting and retaining asbestos fibers.

1.3.26 Lockdown: Procedure of applying an encapsulant as a protective coating or sealant to a surface from which ACM has been removed in order to control and minimize airborne asbestos fiber generation that might result from residual asbestos-containing debris.

1.3.27 Movable Object: A unit of equipment or furniture which can be removed from the work area.

1.3.28 Occupational and Radiation Protection Programs (ORPPs): Set of policies, procedures, and instructions to protect workers, the general public and the environment.

1.3.29 Remedial Project Manager (RPM): Victor J. Janosik, EPA Region 3.

1.3.30 Plasticize: To cover floors and walls with plastic sheeting as herein specified.

1.3.31 Personnel Decontamination Enclosure System: A decontamination system for personnel and limited equipment, typically consisting of an equipment room, shower room, and clean room, with an air lock between any two adjacent rooms, and a curtained doorway between the equipment room and the work area, and a curtained doorway between the clean room and the non-work area. The decontamination system serves as the only entrance/exit for the work area.

1.3.32 Powered Air Purifying Respirator (PAPR): Either a full facepiece, helmet, or hooded respirator that powers breathing air to the wearer after the air has been purified through a HEPA filter.

1.3.33 Removal: The act of removing and transporting radioactive and/or asbestos-containing materials from the work area to a suitable disposal site.

1.3.34 Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

1.3.35 Wet Cleaning: The process of eliminating radioactive and asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with amended water.

1.3.36 Work Area: Designated rooms, spaces, or areas of the project where abatement actions are to be undertaken or which may become contaminated as a result of such abatement actions.

1.4 REQUIREMENTS AND QUALIFICATIONS

1.4.1 Minimum Experience: The Contractor shall have at least two years experience with radioactive material and asbestos abatement work, as evidenced through participation in at least five abatement projects of which two are of a complexity comparable to this project.

1.4.2 Radioactive Material Removal Training and Qualifications:

1.4.2.1 All Contractor personnel shall have successfully completed and be certified in the following training programs and other applicable training programs not listed below:

1.4.2.1.1 General Employee Training: General employee training in compliance with Title 10 CFR Part 19.12 will be required for all personnel involved with radioactive materials or working in the vicinity of radioactive materials.

1.4.2.1.2 Respiratory Protection: Respiratory protection training will be implemented to meet project requirements in compliance with ANSI Z-88.2, NRC Reg Guide 8.15, NRC NUREG-0041 "Manual of Respiratory Protection" and 29 CFR 1910.134.

1.4.2.1.3 Hazard Communications: Hazard communications training in compliance with 29 CFR 1910.1200 will be conducted as applicable.

1.4.2.1.4 Technical Training: Job activity simulations or briefings shall be conducted to ensure proper handling and use of equipment, health and safety issues, and as low as reasonably achievable (ALARA) considerations. These will depend upon the task and personnel and will be documented in the training record.

1.4.2.2 The Contractor shall prepare a site specific Health and Safety Plan and Radiation Protection Plan (RPP) for approval by the Contracting Officer for the Austin Avenue radiation remediation projects which shall consist of a set of policies, procedures, and

instructions to protect workers, the general public, and the environment. Refer to Section 01450, ENVIRONMENTAL HEALTH AND SAFETY REQUIREMENTS.

1.4.3 Asbestos Removal Training and Qualifications: The contractor's job supervisors, foremen, and workers who will be involved in asbestos abatement in this project shall be adequately trained and knowledgeable in the field of asbestos abatement. All phases of the work shall be executed by skilled craftsmen experienced in each respective trade. Proof of such experience shall be submitted upon request to the Contracting Officer.

1.4.3.1 The Contractor's on-site job supervisor who will be involved in asbestos abatement shall have successfully completed, within the last twelve months, the EPA-approved course "Supervision of Asbestos Abatement Projects" taught at an EPA-approved Asbestos Information and Training Center or at any other educational institution deemed adequate by the Contracting Officer.

1.4.3.2 The job supervisors and foremen who will be involved in asbestos abatement shall be thoroughly familiar with and experienced in asbestos removal and related work and shall meet the requirements of a competent person set down in OSHA Standard 29 CFR 1926.58.

1.4.3.3 All contractor personnel who will be involved in asbestos abatement shall be knowledgeable, qualified, and trained in the removal, handling, and disposal of asbestos material and in subsequent cleaning of the affected environment. All workers who will be involved in asbestos abatement shall be certified as having attended and satisfactorily completed asbestos worker training in accordance with OSHA Standard 29 CFR 1926.58(k)(3).

1.4.3.4 The Contractor's job supervisors, foremen, and workers who will be involved in asbestos abatement shall be certified and licensed as required by the Commonwealth of Pennsylvania.

1.4.3.5 Prior to commencement of work, all personnel who are to enter the work area shall be instructed in and shall be knowledgeable of the appropriate procedures for personnel protection, radiation remediation, and asbestos abatement. On-site training in the use of equipment and facilities unique to this job site shall be performed. Emergency evacuation procedures from the work area shall also be included in worker training.

1.4.3.6 Supervision Requirements: The Contractor shall provide adequate job supervision for all phases of the project involving asbestos abatement work.

1.4.3.6.1 The Contractor shall have a designated job supervisor present on site whenever work described in this Section is in progress. If the job supervisor leaves the site for any reason, all work described in this Section shall be stopped.

1.4.3.6.2 The Contractor shall furnish one or more foremen who are familiar and experienced with asbestos removal and its related work, safety procedures, and equipment.

1.4.3.6.3 The job supervisor and/or one or more foremen shall be required to be continually inside each work area whenever work (preparation, removal, or cleaning) is in progress.

1.4.3.7 Certificate of Worker's Release: Each asbestos abatement worker, workers of other trades, or any supervisory personnel who enter the contaminated work area shall submit a Certificate of Worker's Release.

1.4.3.8 SUBMITTALS: Unless noted otherwise, the Contractor shall submit to the Engineer five copies of each submittal for review and/or approval.

1.4.3.9 Pre-Work Information: The Contractor shall provide the pre-work submittal items listed herein within five days after receipt of Notice of Award but not fewer than ten days prior to beginning work, unless noted. Written approval of all pre-work submittals must be obtained from the Contracting Officer or RPM prior to start of any asbestos abatement work specified in this Section.

1.4.3.9.1 Documentation of compliance with all requirements of paragraph "Requirements and Qualifications" of this Section. Submittals for all personnel who will be involved in asbestos abatement shall include:

- a. Proof of work experience and successful completion of required EPA-certified training courses for the Contractor's job supervisors, foremen, and workers.
- b. Proof that the job supervisors, foremen, and asbestos abatement workers meet State certification and license requirements.
- c. Provide the name of the designated job supervisor(s) and foremen.
- d. Proof of a current medical surveillance program for all Contractor's personnel to work on this project.
- e. Completed and notarized Certificate of Worker's Release for each asbestos abatement worker, workers of other trades, or supervisory personnel who enter the work area or otherwise contact ACM. Example text for the Certificate of Worker's Release form is presented in the Appendix at the end of this Section.

1.4.3.9.2 Manufacturer's literature on all proposed job related equipment and products to be used. Include Material Safety Data Sheets (MSDS) for encapsulants, mastic removal products, and other chemicals to be used on this project.

1.4.3.9.3 Certification from the encapsulant manufacturer that the encapsulant to be used is compatible with finish materials and with the operating temperatures of the systems to be encapsulated.

1.4.3.9.4 Proof of written notification and compliance with all requirements of paragraph "Permits, State Licenses, and Notifications" of this Section. Proof that all required permits have been obtained.

1.4.3.9.5 Proof of written notification to the local police department and fire department that radioactive materials and asbestos abatement work are being conducted. As a minimum, the notification letter shall include the address of the Facility, dates work is to be performed, and drawings indicating the areas to undergo remediation.

1.4.3.9.6 Proof that a landfill site has been located, and arrangements for transport and disposal of radioactive waste and asbestos-containing or asbestos-contaminated materials have been made.

1.4.3.9.7 Shop drawings (with dimensions and locations) of proposed decontamination facilities and work areas. These drawings shall indicate which areas will be sealed off, proposed layout of the decontamination systems, and location of the AFD(s) and pressure differential recorder. Include a detailed description of any modifications or changes to be made to the specified negative pressure work area enclosure.

1.4.3.9.8 Specimen of the daily log proposed for use. Minimally, the log should include the date(s) and time(s) when all personnel enter and leave the work area(s).

1.4.3.10 Asbestos Abatement During-Work Information: The Contractor shall provide the information described herein to the Contracting Officer at the time specified. Untimely submittal of information may be cause for halting work.

1.4.3.10.1 A "Request For Services" form shall be submitted at least 24 hours in advance of required air monitoring tests to be performed by the testing laboratory.

1.4.3.10.2 Results of all air monitoring performed by the Contractor shall be posted within 24 hours after collection for all workers to see. A copy of the results shall be submitted to the Contracting Officer at the same time.

1.4.3.10.3 Differential Air Pressure Readings: Results of the strip chart record of the work area pressure within 24 hours after the recording was made for all areas where abatement is performed under negative pressure.

1.4.3.11 Post-Work Information: The Contractor shall provide the information described herein to the Contracting Officer before final payment is authorized.

1.4.3.11.1 Notarized copies of a daily log showing the date(s) and time(s) of entrance to and exit from the work area(s) for all persons.

1.4.4 Testing Requirements and Responsibilities

1.4.4.1 Radioactive Material Removal Final Clearance Testing Requirements and Responsibilities of the Contractor

1.4.4.1.1 Soil Sampling

Soil samples shall be collected by the Contractor and analyzed at his expense in areas where contaminated soil has been removed to ensure the clean-up process has met the clearance criteria of: 5.0 picocuries per gram, specific activity for radium 226 in dry soil when the thorium:radium ratio is greater or equal to 4:1; or 15 picocuries per gram, specific activity for radium 226 in dry soil when the thorium:radium ratio is less than 4:1. Samples shall be collected as follows:

- a. Sample locations should be identified and given a unique sample number. Pin flags can be used to mark the location of the sample as necessary.
- b. Collect samples in a clean, glass sample container provided by the laboratory. Label each container with the sample number, date, and initials of the technician.
- c. A stainless steel or disposable plastic scoop should be used to place the soil into the sample container. Stainless steel scoops must be decontaminated between sample locations and screened for radioactivity prior to use at the next site. When using a disposable plastic scoop, a new scoop must be used at each location.
- d. A chain-of-custody should be completed and sent with the samples to the laboratory. Samples should be analyzed for radium 226.

1.4.4.1.2 Removable Surface Contamination Sampling

Smear samples shall be collected by the Contractor and analyzed at his expense to determine the amount of removable contamination present on a surface. Smear samples involve the use of smear (a.k.a. a wipe) which is a circular piece of paper or cloth attached to a folded envelope to protect the collection media. Smears are available from the NU-CON Products Corporation, Laboratory Safety Supply or other similar safety supply company. Smear samples should be collected using the following procedure:

- a. The technician should don a pair of disposable latex (surgical type) gloves to prevent contamination of the hands and cross-contamination between sample locations.

b. The technician should tape a template with a 100 square centimeter opening to the surface to be sampled. The template should be given a unique sample number which identifies the location of the sample.

c. Use the smear to thoroughly wipe the area within the 100 square centimeter area.

d. Fold the envelope cover over the smear and write the sample number, date, and initials of the technician on the cover.

e. Complete a chain-of-custody form and send it along with the smear samples to the laboratory.

Smear sample results may not exceed 20 disintegrations per minute (dpm) of removable contamination per 100 square centimeters of surface area.

1.4.4.1.3 Fixed Surface Contamination Survey

A survey shall be performed by the Contractor to determine the amount of fixed (non-removable) surface contamination which remains after the clean-up process. The amount of fixed alpha radiation will be measured with a portable survey meter utilizing a alpha scintillation detector (Ludlum Model 43-1 or equivalent). The survey will be completed as follows:

a. Check to see if the instrument has been factory calibrated within the past year. A calibration label should be visible on the survey instrument. If the instrument has not been calibrated within the past year, obtain an instrument which has been calibrated within the past year.

b. Perform a battery check on the instrument to ensure that the batteries are sufficiently charged.

c. Observe the surface of the probe face to ensure that there are no tears or holes in the probe face.

d. Using a plated radium 226 source, determine the detector efficiency as follows:

1. Place the probe on top of the source.
2. Record the number of counts per minute (CPM) registered by the survey meter.
3. Divide the activity in disintegrations per minute provided with the plated source by the number of counts per minute registered by the survey meter to obtain an efficiency factor for the survey meter in dpm per cpm.

e. Slowly survey the surface area by placing the probe face as close as possible to the surface a recording the number of counts per minute.

f. Multiply the highest count per minute reading obtained during the survey times the efficiency factor (dpm/cpm) to obtain total disintegrations per minute.

The amount of fixed surface contamination should not exceed 200 disintegrations per minute.

1.4.4.2 Asbestos Abatement Testing Requirements and Responsibilities: Air monitoring will be performed before, during, and after asbestos removal to document asbestos fiber concentrations. The Contractor shall be responsible for personal air monitoring to determine employee exposure and the level of respiratory protection required, inside and outside the work area, and for performing clearance testing/post removal screening. The following paragraphs identify specific responsibilities.

1.4.4.2.1 The Contractor shall employ an industrial hygiene (IH) testing laboratory for air monitoring and clearance testing. The IH technician(s) assigned to the monitoring shall be supervised by an Industrial Hygienist certified by the American Board of Industrial Hygiene (A.B.I.H.). The Contractor shall provide all tests required by specified applicable regulations, codes, and standards and any other tests for his use.

1.4.4.2.2 Daily air samples shall be collected. Air samples shall be collected during each shift from the work area, at the AFD exhaust, at the decontamination enclosure clean room, and in adjacent areas. From each work area the Contractor shall collect and analyze personal air monitoring and work area (inside) samples. Sampling shall be repeated during each different work activity. Sample collection and analysis shall be performed using the OSHA Reference Method as outlined in 29 CFR 1926.58, Appendix A. Results of Contractor testing will be provided to the Engineer within 24 hours after completion of the tests.

1.4.4.2.3 Final clearance testing will be collected and analyzed. The fiber concentration of each sample must comply with the specified clearance level when aggressive sampling techniques are used.

1.4.4.2.4 The Contractor shall be advised whenever questions arise concerning compliance with standards of quality and completeness of the work, and shall use his best efforts to resolve any such questions to the satisfaction of the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

Materials furnished under this section shall be standard products of manufacturers regularly engaged in the production of the items and shall conform to OSHA Standard 29 CFR 1926.58; EPA Standard 40 CFR 61, Subpart M; Department of Transportation Standards 49 CFR 171, 172, and 173; applicable state regulations; and requirements specified herein.

2.1.1 Plastic: Plastic or Polyethylene Sheet of 4-mil and 6-mil thickness shall be provided in rolls of sizes which will minimize the frequency of joints and shall be fire retardant.

2.1.2 Duct Tape: Duct tape shall be capable of sealing joints of adjacent sheets of plastic and of attaching plastic sheeting to finished surfaces without damage to existing finish and shall be capable of adhering under both dry and wet conditions, including use of amended water.

2.1.3 Surfactant: Surfactant (Wetting Agent) shall consist of resin materials in a water base, which have been tested to ensure materials are non-toxic and non-irritating to skin and eyes and are non-carcinogenic.

2.1.4 Encapsulants: Encapsulants used during this work shall be compatible with the finish materials which are to be installed on encapsulated surfaces after asbestos abatement work is completed. The encapsulant shall carry a Class "A" fire resistance rating and shall have an ASTM E-162 flame spread index of 15 or less. A tint shall be given by the Contractor to the encapsulant by means of the addition of non-toxic, nonflammable colorings before application. The encapsulant shall be installed according to the manufacturer's written instructions.

2.1.5 Silicone Sealant: Silicone Sealant shall be single component, solvent curing silicone sealant with 25% elongation capacity, -65°F to 450°F service range. Sealant shall be used to seal space around pipes when constructing a permanent barrier air seal. Sealant membrane shall be not less than 1/8" and not greater than 3/8" thick. Sealant shall be applied against a backer rod, fiberglass mat, or other suitable backup material. Sealant application shall be according to the manufactures written instructions.

2.1.6 Caulking Sealant: Caulking sealant shall be single component, non-sag elastomer with 1600% elongation capacity. Sealant shall meet the requirements of Federal Specification TT-S-00230C, Class A Type II. Sealant shall be used to form an airtight seal around plywood barriers or temporary partitions, to seal along the seams of the

decontamination enclosure system's plywood sheathing, and to seal around piping or other small penetrations of the work area. Sealant application shall be according to the manufactures written instructions.

2.1.7 Foam Sealant: Foam Sealant shall be expanding urethane foam sealant with an ASTM E-162 flame spread index of 25 or less and an operating temperature range between -30°F and 250°F.

2.1.8 Plywood: Plywood used for temporary partitions, decontamination enclosure systems, and tunnels shall be an exterior grade and a minimum 3/8-inch thick.

2.1.9 Spray Adhesive: Spray Aerosol Adhesive shall be specially formulated to stick to sheet polyethylene (3M 76, 3M 77, BF Goodrich S707, or equivalent).

2.1.10 Other Materials: All other materials, such as lumber, plywood, tools, scrapers, brushes, cleaning materials, adhesive, nails, hardware, etc., which are required to perform the work described in this Section shall be provided. Materials and equipment shall be new, in serviceable condition, and appropriate for the intended purpose.

2.1.11 Glovebags: Glovebags shall be manufactured of clear polyethylene material with shoulder length gloves, clear-plastic tool pouch and side port(s). Gloves shall be heat sealed to sleeves. No sewn type glovebags will be allowed. All bags shall be a minimum thickness of six mils. Glovebags shall be provided in sizes best suited for the work.

2.1.12 Disposal Bags: Plastic Disposal Bags shall be a minimum of six mils in thickness. Bags shall be labeled in accordance with this Section.

2.1.13 Shipping Containers

a. Non-Radioactive Wastes - Impermeable Containers shall be suitable to receive and retain any asbestos-containing or asbestos-contaminated materials until they are disposed of at an approved facility. The containers shall be labeled in accordance with this Section. Containers shall be both airtight and watertight and conform to DOT Standard 49 CFR 178.224. Each container shall be constructed of fiber, hard plastic, or metal, with locking, airtight lids.

b. Radioactive Wastes - Refer to Section 3.9 of this Specification.

2.1.14 Warning Signs: Warning Signs shall be posted at the perimeter of the work area prior to abatement operations in accordance with all applicable regulations.

2.1.15 Warning Labels: Warning Labels shall be permanently affixed to all bags and containers containing non-radioactive ACM, in accordance with OSHA Standard 29 CFR 1926.58(k)(2) and DOT Standard 49 CFR Part 171 and 172. Danger label format and

color shall conform to OSHA Standard 29 CFR 1926.200. DOT label format and color shall conform to DOT Standard 49 CFR 172.407. Labels shall display the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG
DISEASE HAZARD
and
RQ HAZARDOUS SUBSTANCE,
SOLID, N.O.S.
ORM-E, NA 9188
(ASBESTOS)

2.2 EQUIPMENT

Equipment furnished under this section shall conform to applicable federal and state regulations, local codes, and the requirements specified herein.

2.2.1 Spraying Equipment: Equipment used to apply amended water shall be of a low pressure type to prevent material disturbance of the asbestos prior to physical controlled removal. Asbestos encapsulant shall be spray-applied by airless method.

2.2.2 Air Filtration Device (AFD): For local exhaust ventilation and work area air filtration, high efficiency particulate air (HEPA) filtration systems equipped with filtration equipment which complies with ANSI Z9.2. shall be provided. Air movement systems or air filtering equipment should not discharge unfiltered air outside the work area. A sufficient quantity of AFD's shall be used in order to provide one work place air change every 15 minutes. To calculate the total air flow movement:

$$\text{Total Cubic Feet Per Minute (CFM)} = \frac{\text{Vol. of Work Area in ft}^3}{15 \text{ minutes}}$$

To calculate the number of units needed for the abatement:

$$\text{No. units needed} = \frac{\text{Total CFM}}{\text{capacity of AFD in CFM}}$$

Work area exhaust must be sufficient to maintain the required negative pressure (vacuum) in the work area, with respect to the adjacent surrounding non-work areas. Provisions shall be made to change filters without releasing captured asbestos fibers to the surroundings.

2.2.3 Differential Air Pressure Recording Device: A continual strip record of the pressure differential between the work area and the adjacent non-work areas shall be provided. Strip chart shall show the time on the horizontal axis and work area vacuum on the vertical axis.

2.2.4 Electrical Service: Compliance with applicable standards of the National Electric Code (NEC); Underwriter's Laboratories (UL); OSHA; local building codes; and regulations governing equipment, materials, layout, and installation of temporary electric service shall be ensured by the Contractor.

2.2.4.1 Lighting: Temporary lighting within the work area and decontamination systems shall be provided by Contractor. Minimum illumination level in the work area shall be ten footcandles.

2.2.4.2 Ground Fault Interrupters: The Contractor shall provide and use ground fault circuit interrupters on all electric power service used in the work area and in decontamination enclosure systems.

2.2.5 Fire Extinguishers: Type "ABC" dry chemical extinguishers or a combination of several extinguishers of NFPA recommended types for the fire hazard exposures in each extinguisher location shall be provided. Minimum size of extinguisher shall be 4-A, and 40-B:C. Supply a minimum of one extinguisher for every 1,500 square feet of floor area, with a maximum travel distance to an extinguisher of 75-feet. Supply at least one extinguisher in each decontamination enclosure equipment room, and clean room.

2.3 DECONTAMINATION ENCLOSURE SYSTEMS

The Contractor shall provide a personnel decontamination enclosure system, and an equipment decontamination enclosure system in accordance with OSHA standards, and as specified herein.

2.3.1 Structure: Use modular systems or build using wood or metal frame studs, joists, and rafters placed at a maximum of 24 inches on-center. Interior shall be sheathed with plywood caulked or taped airtight at joints and seams. Interior and exterior shall be lined with two layers of 6-mil plastic sheeting, with a minimum overlap of 16 inches at seams and sealed (airtight) by tape and adhesive. If decontamination enclosure system is constructed outside of building, provide plywood on exterior and make structure weatherproof. Compliance with local building codes and other regulations governing temporary structures shall be ensured by the Contractor.

2.3.2 Curtained Doorways: Three overlapping sheets of 6-mil polyethylene shall be placed over a framed doorway and secured along the top of the doorway. Secure the vertical edge of the outer sheet along one vertical side of the doorway and the vertical

edge of the second sheet along the opposite vertical side of the doorway. The sheets shall be weighted so that they close quickly after being released.

2.3.3 Air Locks: Air locks shall consist of two curtained doorways placed a minimum of three feet apart.

2.3.4 Personnel Decontamination Enclosure System: This system shall be the only entrance/exit for the work area. The decontamination enclosure system shall be placed adjacent to the work area and shall consist of three totally enclosed chambers and a gross clean-up system as follows:

2.3.4.1 Workers' Gross Clean-up System: Just inside the work area and immediately adjacent to the equipment room, a workers' gross clean-up system will be used for removal of dust, debris, or loose material from protective clothing and footwear. This area is to be separated from the equipment room by a curtained doorway. A "hand-held" water device or shower shall be provided to facilitate the gross removal of loose material. A plastic wading pool approximately 36 inches in diameter shall be provided for gross removal of material from footwear.

2.3.4.2 Equipment Room: The equipment room shall have a curtained doorway to separate it from the work area (the workers' gross clean-up area), and share a common air lock with the shower room. The equipment room shall be large enough to accommodate at least one worker (allowing him enough room to remove his protective clothing and footwear), a 6-mil disposal bag in an impermeable container, and any other equipment which the Contractor wishes to store when not in use.

2.3.4.3 Shower Room: The shower room shall have two common air locks: one which separates it from the equipment room and one which separates it from the clean room. The shower room shall contain at least one shower with hot and cold water per eight workers. Careful attention shall be given to the shower to ensure against leaking of any kind. The Contractor shall supply shampoo and soap in the shower room at all times.

2.3.4.4 Clean Room: The clean room shall share a common air lock with the shower room and shall have a curtained doorway to separate it from outside non-contaminated areas. The clean room shall be sized to adequately accommodate the work crew. Clean disposable clothing, replacement filters for respirators, clean dry towels, and other necessary items shall also be provided in the clean room. A hinged, lockable door shall be placed at the entrance into the clean room to prevent unauthorized access into the work area. The clean room shall not be used for storage of tools, equipment, or materials or as office space.

2.3.5 Equipment Decontamination Enclosure System: This system is located adjacent to the work area. The equipment decontamination enclosure system, consisting of two totally enclosed spaces, shall be constructed as follows:

2.3.5.1 Equipment Washroom: An equipment washroom shall have two air locks: one adjacent to the work area and one common air lock which separates it from the holding area. The washroom shall have facilities for washing material containers and equipment. Gross removal of dust and debris from contaminated material containers and equipment shall be accomplished in the work area, prior to moving to the washroom.

2.3.5.2 Holding Area: A holding area shall share a common air lock with the equipment washroom and shall have a curtained doorway to outside areas. A hinged, lockable door shall be placed at the holding area entrance to prevent unauthorized access into the work area.

2.3.6 Decontamination Enclosure System Utilities: Lighting, heat, and electricity shall be provided as necessary by the Contractor, and as specified herein.

2.4 TEMPORARY PARTITIONS

2.4.1 Temporary Partitions: Temporary partitions shall extend from the floor to the ceiling and form an airtight seal. They shall be built using wood or metal framing at 24-inch on-center faced with plywood sheathing on both sides and shall be braced as necessary. Both sides of the temporary partition shall be covered with a double layer of 6-mil plastic sheeting, with joints staggered and sealed with tape. Edges of the temporary partition at the floor, walls, and ceiling shall be taped and caulked airtight.

PART 3 EXECUTION

3.1 PREPARATION OF WORK AREA

The following Subparagraph "General Preparations" outlines procedures applicable to all enclosed work areas. Work procedures specific for preparing a removal area is addressed below:

3.1.1 General Preparations:

3.1.1.1 Request that the IH technician perform area monitoring and establish a background count prior to the masking and sealing operations for each removal area.

3.1.1.2 Erect barricades; post notices and warning signs.

3.1.1.3 Provide and install decontamination enclosure systems in accordance with Paragraph "Decontamination Enclosure Systems" of this Section.

3.1.1.4 Provide a system to collect all water used by the Contractor in the work areas. Collected water shall be added to waste and/or placed in plastic lined leak-tight drums and/or solidified with an acceptable and approved polymer and disposed of as contaminated waste.

3.1.1.5 Ensure that the Contractor's communication equipment is in place, in operating condition, and in operation during work described in this section.

3.1.1.6 Separate by means of airtight barriers (temporary partitions) parts of the building that are not included in the work area(s) from parts of the building that will undergo removal activity.

3.1.1.7 Seal with temporary partitions. Open doorways, cased openings, and corridors which will not be used for passage during work.

3.1.1.8 Completely seal airtight and isolate the work area. All openings, including but not limited to doorways, windows, tunnels, cracks, openings through which pipe conduit passes, and any other penetrations of the work area, shall be covered with plastic sheeting taped or caulked airtight.

3.1.1.9 Maintain emergency and fire exits from the work areas or establish alternative exits satisfactory to the local fire officials. Emergency exits and routes shall be established and clearly marked with duct tape arrows or other effective designations to permit easy location from anywhere within the work area. Emergency exits shall be secured to prevent access from uncontaminated areas and yet permit emergency exiting.

3.1.1.10 After sealing and plasticizing the area, install and initiate operation of air filtration devices (see Subparagraph "Air Filtration Devices (AFD's)" of this Section) to provide a negative pressure of at least -0.02 inches of water within the work area relative to surrounding non-work areas. Modifications or changes made to the specified negative pressure work area enclosure must be approved by the Contracting Officer (see Paragraph "Submittals").

a. Locate AFD's so that makeup air enters the work area mainly through the worker entrance and transverses the work area as much as possible.

b. Once they are operational, do not shut down AFD's until the work area is released to the Contracting Officer or his representative following final clearance procedures.

3.1.2 Radioactive Material and ACM Removal Area Preparations: The Contractor shall perform the following preparations in conjunction with those outlined in Subparagraph "General Preparations", for each area to undergo removal activity.

3.1.2.1 Work Area Precleaning Procedures: After establishing the decontamination enclosure systems, prepare and preclean the work area as specified below and/or as indicated by the drawing notes:

a. Movable and loose items not removed by the EPA from work areas shall be cleaned using HEPA vacuum equipment and/or wet cleaning methods as appropriate and shall be removed from work areas to a temporary location designated by the Contracting Officer. These items will be received by and protected from damage or loss by the Contractor and reinstalled by the Contractor after final clearance.

b. Prior to being plasticized, the work areas shall be cleaned using HEPA vacuum equipment and/or wet cleaning methods as appropriate. Methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, shall not be used.

c. Fixed objects within the work area shall be precleaned using HEPA-vacuum equipment and/or wet cleaning methods as appropriate. Fixed objects shall be enclosed with a minimum of two layers of 6-mil plastic sheeting sealed airtight with tape. Disassembly of fixed objects is not required unless otherwise noted.

3.1.2.2 Plasticize the area after precleaning (if applicable), using the following procedure:

a. Cover floor with one layer of 6-mil plastic sheet, turning layer a minimum of 16 inches up wall, and seal layer to wall (if applicable).

b. Cover walls with one layer of 4-mil plastic sheet, lapping wall layer a minimum of 16 inches, and seal layer to floor layer.

c. Repeat procedure for second layer. All joints in plastic sheets shall be glued and taped in such a manner as to prohibit air passage. Joints on plastic layers shall be staggered to reduce the potential for water to penetrate.

3.1.2.3 Areas immediately adjacent to removal areas, such as corridors or hallways which are not in work areas but are necessary routes to and from work areas, shall be protected with two layers of 6-mil plastic sheet on floors and two layers of 4-mil plastic sheet on walls and ceilings. The Contractor is permitted to provide plastic-enclosed, framed-in tunnels in lieu of plasticizing walls and ceilings. Openings from these areas into areas where asbestos material is removed shall have curtained doorways to minimize fiber dispersal into adjacent areas.

3.2 PRE-REMOVAL INSPECTION

Prior to removal of any ACM the Contractor shall notify the Contracting Officer or his representative and request a pre-removal inspection. Posting of warning signs, construction of temporary partitions, plasticizing of work area, building of personnel and equipment decontamination enclosure systems, and all other preparatory steps shall have been taken prior to notification of the Contracting Officer or his representative. The Contractor shall not begin removal until the Contracting Officer or his representative approves the work area preparations.

3.3 MAINTENANCE OF ENCLOSED WORK AREA AND DECONTAMINATION ENCLOSURE SYSTEMS

3.3.1 Ensure that barriers and plastic linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon their discovery. Visually inspect enclosures at the beginning and end of each work period. Use smoke methods when directed by the Contracting Officer or his representative to test effectiveness of barriers.

3.3.2 Thoroughly clean the decontamination enclosure systems at the end of each 8-hour work shift, and more frequently if required.

3.4 REMOVAL OF RADIOACTIVE MATERIAL AND ASBESTOS-CONTAINING MATERIAL (ACM)

3.4.1 General: The Contractor shall be responsible for the proper removal of radioactive material and ACM from the work area using standard abatement industry removal techniques. Work shall be observed by the Contracting Officer or his representative. Approval of the Contractor's abatement techniques is required by the Contracting Officer or his representative to allow for the continuance of work.

3.4.1.1 Radioactive material and ACM shall be wetted with amended water or removal encapsulant prior to being disturbed. Keep material wet during removal through to the disposal of these materials (material packed in disposal containers shall be in a wet condition).

3.4.2 The Contractor shall use methods and equipment which will keep the fiber count during asbestos removal operations to less than 0.2 fibers/cc of air when tested by NIOSH Method 7400. During the radioactive material removal the Contractor shall use methods and equipment which will keep the emission of radium dust as low as reasonably achievable (ALARA).

3.4.3 Glove Bag Removal of Insulation and Lagging on Pipes and Fittings: The Contractor shall use the procedure as described below when using the glove bag technique for the removal of ACM from piping. The Contractor shall use methods and

equipment which will keep the fiber count during removal operations to less than 0.1 fibers/cc of air when tested by NIOSH Method 7400.

3.4.3.1 Glove Bag Procedure for a Contained Work Areas:

a. Prepare the area as described in Subparagraph "Radioactive Material and ACM Removal Area Preparations" of this Section.

b. Place the glove bag around the section of pipe to be worked on, secure glove bag, and reinforce it. Glove bags shall provide an airtight seal around the area from which the asbestos is to be removed. Check for leakage by introducing smoke into the bag and then gently squeezing the bag with hand pressure. If any leaks occur, the bag shall be resealed and retested until no leakage occurs. This seal shall be continually maintained until all asbestos has been removed from the equipment surface enclosed within the glove bag.

c. If the section of pipe is covered with an aluminum jacket, this is removed first. It is important to fold in the sharp edges of the jacket to prevent cutting the bag when it is placed in the bottom. With the insulation exposed, cut the insulation inside the glove bag at each end of the section to be removed. Slit insulation from end to end and remove insulation from pipe. Throughout this process spray water on the cutting area to keep dust to a minimum.

d. When all insulation is removed, introduce water spray into glove bag and carry out recommended washing down procedure (tools, pipe, and upper half of bag). Scrub and wipe down the exposed pipe inside the glove bag. Apply lockdown sealant to all exposed insulation and pipe.

e. Remove excess air from glove bag with HEPA vacuum and remove glove bag from pipe. Continuous stripping or sliding of the glove bag shall not be allowed. Use glove bag for only one application prior to disposal. Place glove bag in a plastic disposal bag and seal bag prior to placing it in a labeled drum for transport.

3.4.3.2 Modified Glove Bag Procedure for Non-Contained Removal Areas: Where glove bag removal is required in non-contained work areas, the following modified glove bag technique shall be used.

a. Prior to attachment of the glove bag, modify the bag so as to allow make-up air to enter the bag through a port, but not leave the bag. This may be accomplished by the addition of a poly flap which is taped inside the bag over an opening cut into the bag.

b. Once the bag is applied to the area to undergo abatement, attach a small HEPA filtered vacuum unit to the bag to create negative pressure within the modified glove bag. The addition of a supporting frame may be required to prevent collapse of the bag.

c. The modified glove bag shall be installed, used, and detached as stated in Subparagraph "Glove Bag Procedure for a Contained Work Areas."

3.4.4 Floor Tile: The work area shall be prepared as described in Subparagraph "Radioactive and ACM Removal Area Preparations" of this Section. If floor tile is the only ACM to be removed in a work area, modify area preparations to include the following: (1) only plasticize the walls to a height of three feet to protect them from water damage and (2) do not plasticize floor area. The Contractor shall use methods and equipment which will keep the fiber count during removal operations to less than 0.1 fiber/cc of air when tested by NIOSH Method 7400.

The following procedure shall be used for removal of asbestos-containing floor tile and/or mastic.

3.4.4.1 Spray with amended water floors covered with asbestos-containing tile. Wet the material sufficiently to reduce the release of fibers if the tiles are broken upon removal. Continually wet the material during the removal process to minimize fiber dispersion.

3.4.4.2 Remove floor tile using a flat hoe or scraper. Remove adhesive backing using a flat hoe, approved mastic removal solvent, or other suitable method. Do not grind or sand floor.

3.4.4.3 As material is removed, wrap it in two layers of plastic and place it in labeled containers for transport. After completion of all stripping work, scrape, wet-brush, and wipe floor. No tile or mastic residue shall remain on the floor surface following removal and cleaning.

3.4.5 Additional Removal Requirements

3.4.5.1 Stop Work Order: The Contracting Officer or his representative shall issue a stop work order should the concentration of radium dust and/or fiber in work areas exceed the maximum allowable concentrations specified. The Contracting Officer or his representative shall stop work in work areas should the concentration in adjacent non-work areas exceed 0.01 f/cc of air or the background count. Work shall not resume until the condition(s) causing the increase are corrected by the Contractor and the Contractor receives written notice from the Contracting Officer.

3.5 CLEANUP AND CLEARANCE TESTING OF ASBESTOS WORK AREAS

3.5.1 Clearance Procedure for Asbestos Removal areas: Cleaning of the work areas and other contaminated areas shall be conducted in accordance with the three-step procedure described below.

Step 1.	Preliminary Cleanup	Visual inspection
Step 2.	Lockdown	---
Step 3.	Final Reoccupancy Clearance	Visual Inspection and fiber count ≤ 0.01 fiber/cc of air, using NIOSH Method 7400 or TEM.

3.5.1.1 Step 1. Preliminary Cleanup

- a. Remove visible accumulation of asbestos material and debris. Wet clean all surfaces and objects in the work area and any other contaminated area. Remove asbestos waste in impermeable containers from the work area.
- b. After cleaning the work area, wait 24 hours to allow for the settlement of dust and again wet clean or clean with HEPA vacuum equipment all surfaces in the work area. (Waiting time of 24 hours may be waived by the Contracting Officer.) After completion of the second cleaning operation, perform a complete visual inspection of the work area to ensure that it is free of visible contamination.
- c. Upon request from the Contractor, the Contracting Officer or his representative will perform a visual inspection. If the Contracting Officer or his representative finds visible accumulations of dust in the work area, the Contractor shall repeat the wet cleaning as heretofore specified.

3.5.1.2 Step 2. Lockdown

- a. After successful completion of the preliminary cleanup, all surfaces from which ACM was removed and the remaining layer of protective plastic sheeting shall receive lockdown encapsulant.
- b. When the encapsulant is dry, the layer of plastic sheeting shall be wet cleaned and/or HEPA vacuumed again.
- c. The second layer of plastic shall be removed from walls and floor and shall be folded inward to trap any debris. Do not remove seals from doors, windows, etc. or disconnect the negative pressure equipment.
- d. All exposed surfaces shall be wet cleaned and/or HEPA vacuumed. After cleaning, wait a minimum of 16 hours to allow for settling of dust and then wet clean and/or HEPA vacuum again. (Waiting time of 16 hours may be waived by the Engineer.)

3.5.1.3 Step 3. Final Reoccupancy Clearance (if applicable)

a. Upon request from the Contractor, a final inspection for reoccupancy will be performed by the Contracting Officer or his representative for the purpose of observing whether the condition of cleaned areas is free of dust, dirt, and debris. Evidence of asbestos contamination identified during the inspection will necessitate further cleaning as heretofore specified.

b. When the work area passes the Contracting Officer representatives reoccupancy inspection, the testing laboratory shall test for reoccupancy using aggressive sampling techniques. (Reoccupancy will be approved by the Engineer if the fiber count in the work area is achieved, as reported by the testing laboratory. Failure to achieve this level will necessitate further cleaning as heretofore specified).

3.5.2 All removed asbestos material shall be screened for radioactive contamination. If the asbestos waste is found to be non-radioactive follow the disposal and transportation of asbestos-contaminated waste procedure of this section. If the asbestos waste is found to be radioactive follow the disposal and transportation of radioactive waste procedure of this section. Also see Specification Section 01928, HAZARDOUS WASTE CHARACTERIZATION, DECONTAMINATION, AND DISPOSAL for disposal of the wastes.

3.6 CLEARANCE TESTING OF RADIOACTIVE WORK AREA

Refer to Section 1.4.4.1 of this Specification.

END OF SECTION

SECTION 02100

CLEARING, STRIPPING, OVEREXCAVATION, AND OVEREXCAVATION BACKFILL

PART 1 GENERAL

1.1 DEFINITIONS:

1.1.1 Clearing. Clearing shall consist of the removal and disposal of paving, structures, exposed concrete, rubble, trees, brush, vegetation, rubbish, or other debris exposed at the surface which encroaches upon or otherwise obstructs the work.

1.1.2 Stripping. Stripping shall consist of the removal of concrete, rubble, metal, rubbish or other debris, topsoil, stumps, roots larger than 3 inches in diameter, and any other organic material encountered down to the depth specified in paragraph STRIPPING of PART 3 - EXECUTION. The stripping operation shall also include the stockpiling of topsoil for reuse in required final grassed areas; and the disposal of concrete, rubble, metal, rubbish or other debris, stumps, roots, other organics, and excess topsoil from the stripping operation.

1.2. MEASUREMENT:

1.2.1 General. Separate measurement and payment will only be made for overexcavation and overexcavation backfill as hereinafter specified. All other items of work in this section shall be included in the lump sum price per job under the appropriate Base Bid or additive item of the unit price schedule.

1.2.1.1 Presence of Contracting Officer. All measurements shall be made in the presence of the Contracting Officer.

1.2.1.2 Protection of Records. The Contractor shall preserve all excavations in good condition until final measurement and until the records have been examined and accepted.

1.2.2 Overexcavation. The unit of measurement for overexcavation will be the cubic yard. Overexcavation to be paid for will be the number of cubic yards excavated, measured in the original position; and computed by the average end-area method. Measurements will only include authorized overexcavation below the depth specified hereinafter in paragraph STRIPPING. Overexcavation will be measured for payment on the basis of the number of in-place cubic yards of material actually removed between the excavated surface obtained by the specified clearing and stripping operation, and the depths and lateral limits directed by the Contracting Officer.

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1.2.3 Overexcavation Backfill. The unit of measurement for overexcavation backfill will be the cubic yard. Yardage of backfill to be paid for will be the number of cubic yards of specified backfill material, satisfactorily placed within the hereinbefore specified limits of overexcavation, measured in final compacted in-place position, and computed by the average end-area method. Measurements will only include overexcavation backfill conforming to the requirements specified hereinafter in paragraph OVEREXCAVATION AND BACKFILL.

1.3. PAYMENT:

1.3.1 Overexcavation. Authorized overexcavation will be paid for at the contract unit price per cubic yard under payment Item No. 02100-1, "OVEREXCAVATION," of the Unit Price Schedule. This payment will constitute full compensation for all labor, equipment, tools, supplies, materials, and incidentals necessary to complete the work, including pneumatic hammers or other mechanical or hydraulic splitting equipment necessary to break up concrete or other large rubble prior to its removal.

1.3.2 Overexcavation Backfill. Authorized overexcavation backfill will be paid for at the contract unit price per cubic yard under payment Item No. 02100-2, "OVEREXCAVATION BACKFILL," of the Unit Price Schedule. This payment will constitute full compensation for all labor, equipment, tools, supplies, materials, and incidentals necessary to complete the work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CLEARING: Brush and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface. Clearing shall also include the removal and disposal of paving, structures, exposed concrete, rubble, rubbish, or other debris exposed at the surface that obtrudes, encroaches upon, or otherwise obstructs the work.

3.2 STRIPPING: Unless otherwise shown or directed, all existing areas within the indicated construction areas under this contract, shall be stripped to a maximum depth of 1.5 feet below the original surface level of the ground, as necessary to remove concrete, rubble, metal, rubbish or other debris, topsoil, stumps, roots larger than 3 inches in diameter, and any other organic material not suitable for foundation purposes. Organic, unstable, or otherwise unsatisfactory material, as determined by the Contracting Officer, encountered below the specific maximum depth of stripping shall be removed and replaced, as directed by the Contracting Officer, with suitable material as specified in paragraph OVEREXCAVATION AND BACKFILL.

3.3 OVEREXCAVATION AND BACKFILL: Concrete, rubble, metal, wood, and other construction debris, as well as, organic, unstable, or otherwise unsatisfactory material, as

determined by the Contracting Officer, encountered below the specified stripping depth within the limits of work, shall be removed to the depths and lateral limits as directed by the Contracting Officer. The overexcavation shall be backfilled in accordance with Section 02201, EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS.

3.4 DISPOSAL OF MATERIALS: All cleared, stripped, and overexcavated material exclusive of the stripped topsoil shall be disposed of at the expense and responsibility of the Contractor. The excess topsoil beyond that required for final grassed areas shall be disposed of at the topsoil spoil area located as shown on the drawings, at the Contractor's expense and responsibility.

END OF SECTION

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SECTION 02110
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 REFERENCES (Not Applicable)

1.2 DEFINITIONS

1.2.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.2.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300, SUBMITTAL DESCRIPTIONS:

1.3.1 Materials Other Than Salable Timber

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. Clearing

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shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground after the completion of decontamination and dismantling of the site.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths of ten feet, and stockpiled at locations as directed. The disposal of the stockpiled timber will be by the Government.

3.4.2 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall not be disposed of in the designated waste disposal area or by burning, except when otherwise approved in writing. Such permission will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

END OF SECTION

SECTION 02201

EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to by the basic designation only and represent the latest edition in force when this contract is awarded.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

T-180 Moisture-Density Relations of Soils Using a 10-lb (4.54 Kg) Rammer
and an 18-in (4.57 mm) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

C 117 Materials Finer than 75 um (No. 200) Sieve in Mineral Aggregates by
Washing

C 127 Specific Gravity and Absorption of Coarse Aggregates

C 128 Specific Gravity and Absorption of Fine Aggregates

C 136 Screen Analysis of Fine & Coarse Aggregates

D 422 Particle-Size Analysis of Soils

D 1556 Density of Soil in Place by the Sand-Cone Method

D 1557 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures
Using a 10-lb (4.5 kg) Rammer and 18-in (457 mm) Drop

D 2167 Density and Unit Weight of Soil in Place by the Rubber-Balloon
Method

D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock,
and Soil-Aggregate Mixtures

D 2487 Classification of Soils for Engineering Purposes

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D 2922	Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
D 2937	Density of Soil in Place by the Drive-Cylinder Method
D 3017	Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index for Soils
E 11	Wire-Cloth Sieves for Testing Purposes

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

1.2.1.1 Satisfactory Fill Materials: Fill, embankment, and backfill within the building lines of structures, beneath appurtenant structures, and beneath abutting paved areas shall be those materials classified in ASTM D 2487 as GW, GP, GM, GC, SW, SM, SC, or combinations thereof, properly worked by the contractor to obtain the specified compaction while maintaining the moisture content as specified hereinafter.

1.2.1.2 Satisfactory Subgrade Soils: Satisfactory soils for the subgrade within the building lines of structures, beneath appurtenant structures, and beneath abutting paved areas shall consist of all subgrade soils, except as specified hereinafter in the paragraph Unsatisfactory Material, Subgrade.

1.2.1.3 Other Areas: Material for fill, embankment, and backfill in other areas can be any material except those materials classified in ASTM D 2487 as Pt, OH, and OL."

1.2.2 Unsatisfactory Materials

1.2.2.1 Fill, Embankment, and Backfill: Unsatisfactory materials for fill, embankment, and backfill within the building lines of structures, beneath appurtenant structures, and beneath abutting paved areas shall be those materials not meeting the requirements of paragraph Satisfactory Fill Materials, as defined above.

1.2.2.2 Subgrade

1.2.2.2.1 Satisfactory subgrade soils which are rendered unsuitable by the contractor due to inadequate site and/or excavation drainage or due to negligence by working (remolding) or compacting otherwise satisfactory in place subgrade soils under adverse moisture conditions, as determined by the Contracting Officer, shall be removed and

replaced with satisfactory fill material or shall be worked or altered until rendered suitable as determined by the Contracting Officer, except under concrete foundations as specified hereinafter in paragraph EXCAVATION, at the cost of the Contractor.

1.2.2.2.2 Unsatisfactory materials for the subgrade within the building lines of structures, beneath appurtenant structures, and beneath abutting paved areas shall be those materials classified in ASTM D 2487 as Pt, OH, OL, FILL (where designated on the logs without Unified Soils Classification Symbol), or combinations thereof.

1.2.2.2.3 Other Areas: Unsatisfactory materials for the subgrade in other areas shall be those materials classified in ASTM D 2487 as Pt, OH, OL, FILL (where designated on the logs without Unified Soils Classification Symbol), or combinations thereof.

1.2.3 Cohesionless and Cohesive Materials: Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.2.4 Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in METHOD C of ASTM D 1557, or AASHTO T-180, METHOD D, abbreviated hereinafter as percent laboratory maximum density.

1.2.5 Spoil Areas: Spoil materials shall be properly disposed of at the contractor's expense and responsibility.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

The areas within lines 5 feet outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush, and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be completely removed and the resulting depressions shall be filled with satisfactory material placed and compacted in accordance with paragraph FILLING AND BACKFILLING. Cleared and grubbed materials shall be disposed of in the spoil areas indicated in paragraph Spoil Areas.

3.2 TOPSOIL

Topsoil shall be stripped to its full depth within the designated excavations and grading lines and deposited in storage piles.

3.3 EXCAVATION

The excavation shall conform to the dimensions and elevations indicated for each building and structure, except as specified hereinafter, and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the building line of each building and structure. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms.

3.4 DRAINAGE AND DEWATERING

3.4.1 Excavation shall be performed so that the area of the site and the area immediately surrounding the site and affecting operations at the site will be continually and effectively drained. Water shall not be permitted to accumulate in crawl space areas and in the excavation. The excavation shall be drained by pumping or other satisfactory methods to prevent softening of the foundation bottom, undercutting of footings, or other actions detrimental to proper construction procedures.

3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

3.7 BLASTING

Blasting will not be permitted.

3.8 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained from approved sources at the Contractor's expense and responsibility. Identified borrow sources are listed in Appendix B.

3.9 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and unsatisfactory material shall be disposed of in the spoil areas indicated in paragraph Spoil Areas.

3.10 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary (to obtain plus or minus 2 percent of optimum moisture), thoroughly mixed and compacted as specified. Vibratory methods of compaction are not to be used. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Heavy equipment for spreading and compacting backfilling shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes to avoid damage to coatings or wrappings. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory Cohesive Material	Maximum Density Cohesionless Material
Fill, embankment, and backfill	85	90
Under sidewalks and grassed areas	85	90
<u>Subgrade</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95

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Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified hereinbefore to the required density prior to further construction thereon. Recomposition over underground utilities and heating lines shall be by hand tamping.

3.11 TESTING

Testing shall be the responsibility of the Contractor. Testing shall be performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Tests shall be performed in sufficient number to insure that the specified density is being obtained. Moisture-density relations shall be determined in accordance with the procedure referenced in paragraph Degree of Compaction. Field in-place density shall be determined in accordance with ASTM (D 1556) (D 2167) (D 2922). (When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph "ADJUSTING CALIBRATION CURVE." ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gages shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer.) ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. Approved compacted subgrades that are disturbed by contractor's operations or adverse weather shall be scarified and compacted as specified hereinbefore to the required density prior to further construction thereon. Recomposition over underground utilities and heating lines shall be by hand tamping. Sieve analyses shall be performed in accordance with ASTM C 117, C 127, C 128, C 136, and D 422; sieves shall conform to ASTM E 11; and liquid limit and plasticity index determinations shall be performed in accordance with ASTM 4318. Copies of test results shall be furnished to the Contracting Officer. The following minimum testing at locations selected by the Contracting Officer is required:

3.11.1 Fill, Backfill, and Existing Subgrade Materials (for each classification of material used)

3.11.1.1 Fill and Backfill Material: One sieve analysis (and one liquid limit and plasticity index determination for cohesive soils) per 500 c.y. or fraction thereof.

3.11.1.2 Moisture Contents: A minimum of one test per 250 s.y. or fraction thereof of the subgrade prior to placement of fill or backfill thereon during stable weather conditions. In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.11.1.3 Optimum Moisture and Laboratory Maximum Density: One moisture-density curve to determine the optimum moisture content and the laboratory maximum density values shall be done for each type of subgrade material (fill and cut areas) and one curve shall be done per 1000 c.y. of each type of fill and backfill materials, to include any borrow materials.

3.11.1.4 Additional Testing: Additional gradation, liquid limit, plasticity index determinations, and moisture-density curves shall be required if there is any change in gradation or particle shape or when any change occurs in the material which may affect the optimum moisture content or laboratory maximum density.

3.11.2 Field Density Tests

3.11.2.1 Backfill Materials

3.11.2.1.1 Wall Footings: One per lift per 100 feet or fraction thereof.

3.11.2.1.2 Column Footings: One per lift for each column footing.

3.11.2.2 Fill Material: One per lift per 500 s.y. or fraction thereof.

3.11.2.3 Check Tests on In-Place Densities: If ASTM D 2922 is used, in-place densities shall be check by ASTM D 1556 or as follows:

3.11.2.3.1 Backfill Materials

3.11.2.3.1.1 Wall Footings: One check test per lift per 500 feet or fraction thereof.

3.11.2.3.1.2 Column Footings: One check test per lift for each 5 column footings.

3.11.2.3.2 Fill Material: One check test per lift per 100 s.y. or fraction thereof.

3.11.3 Fill, and backfill areas compacted by hand-operated machines: The minimum number of field density tests and check tests specified above shall be doubled in areas where compaction is accomplished by hand-operated machines.

3.12 GRADING

Areas within 5 feet outside of each building and structure line shall be constructed true to grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.13 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

END OF SECTION

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SECTION 02210

GRADING AND SITE RESTORATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Materials classified in ASTM D 2487 as GW, GP, and SW, and free from roots and other organic matter, trash, debris, and frozen materials and stones larger than 6 inches in any dimension are satisfactory.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Materials classified in ASTM D 2487 as Pt, OH, and OL are unsatisfactory.

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Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

1.2.3 Cohesionless and Cohesive Materials

Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.4 Degree of Compaction

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, Method C abbreviated below as a percent of laboratory maximum density.

1.2.5 Topsoil

Material obtained from offsite areas or excavations suitable for topsoils, is defined as loam or organic bearing material. Also see additional requirements according to the applicable provisions of Section 02935, TURF.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300, SUBMITTAL DESCRIPTIONS:

1.3.1 Field Testing Control

Qualifications of the commercial testing laboratory who will be performing all testing in accordance with Paragraph 3.9, FIELD TESTING CONTROL.

1.3.2 Satisfactory Materials

Certified test reports and analysis certifying that the satisfactory materials proposed for use at the project site conform to the specified requirements, and for all tests conducted in accordance with Paragraph 3.9, FIELD TESTING CONTROL.

PART 2 PRODUCTS

2.1 BORROW MATERIAL

Borrow material shall be selected to meet requirements and conditions of the particular fill for which it is to be used. The Contractor shall submit prepared borrow sources to

Contracting Officer for approval prior to delivering borrow materials to site. The Contractor shall also submit a sampling and analysis plan, for approval by the Contracting Officer, to assure that only uncontaminated materials are used for fill material. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

The source of borrow material shall be the Contractor's responsibility. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expense of developing the sources, including rights-of-way for hauling. Sources of borrow material are listed in Appendix B.

PART 3 EXECUTION

3.1 CONSERVATION OF TOPSOIL

Topsoil shall be removed to full depth and shall be stored separate from other excavated materials and piled free of roots, stones, and other undesirable materials. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 EXCAVATION

After topsoil removal has been completed, excavation of every description, regardless of material encountered, within the designated areas of the project shall be performed to the depths indicated. Satisfactory uncontaminated excavation material shall be transported to and placed in fill areas within the limits of the work. All uncontaminated unsatisfactory material including any soil which is disturbed by the Contractor's operations or softened due to exposure to the elements and water and surplus material shall be removed from site. All contaminated excavation material will be transported to the designated project staging area where it will be prepared for disposal. Excavations carried below the depths indicated, without specific directions, shall, except as otherwise specified, be refilled to the proper grade with satisfactory material as directed. All additional work of this nature shall be at the Contractor's expense. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Excavations shall be kept free from water while work therein is in progress. Material required for fills in excess of that produced by excavation within the grading limits shall be obtained from borrow areas.

3.3 BACKFILL ADJACENT TO STRUCTURES

Backfill adjacent to structures shall be placed and compacted uniformly in such manner as to prevent wedging action or eccentric loading upon or against the structures. Slopes bounding or within areas to be backfilled shall be stepped or serrated to prevent sliding of the fill. During backfilling operations and in the formation of embankments, equipment that will overload the structure in passing over and compacting these fills shall not be

used. Backfill for storm drains and subdrains, including the bedding and backfill for structures other than culverts and drains, shall conform to the additional requirements in other applicable sections.

3.4 FILLS AND EMBANKMENTS

Fills and embankments shall be constructed at the locations and to lines and grades indicated. The completed fill shall conform to the shape of the typical sections indicated or shall meet the requirements of the particular case. Satisfactory material obtained during excavation may be used in forming required fill. Fill shall be satisfactory material and shall be reasonably free from roots, other organic material, and trash and from stones having a maximum diameter greater than 6 inches. No frozen material will be permitted in the fill. Stones having a dimension greater than 4 inches shall not be permitted in the upper 6 inches of fill or embankment. The material shall be placed in successive horizontal layers of 8 inches in loose depth for the full width of the cross section and shall be compacted as specified. Each layer shall be compacted before the overlaying lift is placed. Moisture content of the fill or backfill material shall be adjusted by wetting or aerating, as required, to within plus or minus 2% of optimum moisture content as determined from laboratory tests specified in paragraph DEFINITIONS.

3.5 COMPACTION

Except for paved areas, each layer of the fill or embankment shall be compacted to at least 90% of laboratory maximum density. Areas to be paved and other areas indicated as requiring compaction suitable for paved areas shall be compacted to at least the percentage of laboratory maximum density shown for specific ranges of depth below the surface of the pavement. The Contractor is advised that vibrating rollers will not be used for compaction of fill materials.

3.6 FINISHED EXCAVATION, FILLS, AND EMBANKMENTS

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches and gutters shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turving materials. For subgrade areas to be paved, the following shall be accomplished as required: (a) soft or otherwise unsatisfactory material shall be replaced with satisfactory excavated material or other approved materials; (b) rock encountered in the cut sections shall be excavated to a depth of 6 inches below finished grade for the subgrade; (c) low areas resulting from removal of unsatisfactory material or from excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and shall be

compacted as specified. The surface of embankments or excavated areas for road construction or other areas on which a base course or pavement is to be placed shall vary not more than 0.05 foot from the established grade and approved cross section. Surfaces other than those that are to be paved shall be finished not more than 0.15 foot above or below the established grade or approved cross section.

3.7 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2-inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 4 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from off-site areas.

3.8 SITE VEGETATION

All areas covered by the project will be revegetated except those designated areas that are to be paved. For properties in which Alternatives 4 or 5 will be implemented (structures are to be entirely dismantled), the lots are to be seeded. Any trees or shrubs that are destroyed during removal operations will not be replaced. For properties in which Alternative 2 will be implemented (structures are to be rehabilitated after decontamination), the lots will be seeded. In addition, any trees or shrubs destroyed during removal operations will be replaced with nursery stock of comparable plant type.

3.9 FIELD TESTING CONTROL

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Field density and moisture content tests shall be performed on every 500 square feet of each 1 inch lift placed. Field in-place density shall be determined in accordance with ASTM D 1556.

3.10 PROTECTION

Newly graded areas shall be protected from traffic and from erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades reestablished to the required elevations and slopes. All work shall be conducted in accordance with the environmental protection requirements of the contract.

END OF SECTION

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SECTION 02221

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to by the basic designation only and represent the latest edition in force when this contract is awarded.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) STANDARDS

T 180	Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and 18-inch (457 mm) Drop
T 191	Density of Soil In-Place by the Sand-Cone Method
T 238	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
T 239	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM) PUBLICATIONS

C 117	Materials Finer than 75 um (No. 200) Sieve in Mineral Aggregates by Washing
C 136	Sieve Analysis of Fine and Coarse Aggregate
D 422	Particle-Size Analysis of Soils
D 1556	Density of Soil in Place by the Sand-Cone Method
D 1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop
D 2167	Density and Unit Weight of Soil in Place by the Rubber Balloon Method

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D 2487	Classification of Soils for Engineering Purposes
D 2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
E 11	Wire-Cloth Sieves for Testing Purposes
E 548	Generic Criteria for Use in the Evaluation of Testing and Inspection Agencies

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

1.2.1.1 Satisfactory backfill materials for trenches shall be those materials classified in ASTM D 2487 as GW, GP, GM, GC, SW, SM, SC, or combinations thereof, properly worked by the Contractor to obtain the specified compaction while maintaining the moisture content as specified hereinafter; and may also include SP, CL, ML, CH, MH, or combinations thereof, properly worked by the Contractor to obtain the specified compaction while maintaining the moisture content as specified hereinafter; however, the Contractor should be aware of the possible construction difficulties and the very close moisture control required in the proper field placement and compaction of these latter materials and of any micaceous materials, as compared to the previously classified materials. Satisfactory backfill materials for trenches under paved areas shall be the same materials with the exception that materials classified as CH, MH, or combinations thereof cannot be used.

1.2.1.2 Satisfactory Subgrade Soils. Satisfactory soils for the subgrade of trenches shall consist of all subgrade soils except as specified hereinafter in the paragraph UNSATISFACTORY MATERIALS.

1.2.2 Unsatisfactory Materials

1.2.2.1 Backfill Materials: Unsatisfactory backfill materials for trenches shall be those materials not meeting the requirements of the SATISFACTORY MATERIALS paragraph.

1.2.2.2 Subgrade

1.2.2.2.1 General: Satisfactory subgrade soils that have been rendered unstable, as determined by the Contracting Officer, due to inadequate site and/or excavation drainage or due to negligence on the part of the Contractor by working (remolding) or

compacting otherwise satisfactory in place subgrade soils under adverse moisture conditions shall be removed and replaced with satisfactory fill material or worked or altered until rendered suitable as determined by the Contracting Officer at the cost to the Contractor.

1.2.2.2 Trenches: Unsatisfactory materials for the subgrade of trenches shall be those materials classified in MIL-STD-619 as Pt, OH, OL, FILL (where designated on the logs without Unified Soils Classification Symbol), or combinations thereof. Unsatisfactory materials shall also include those materials containing roots and other organic matter, trash, debris, frozen materials, stones larger than 3 inches, and unstable and unyielding materials as defined hereinafter.

1.2.3 Cohesionless and Cohesive Materials: Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.2.4 Classification of Excavation: All excavation shall be done on the unclassified basis. No consideration will be given to the nature of the materials encountered.

1.2.5 Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches, in any dimension or as defined by the pipe manufacturer, whichever is smaller.

1.2.6 Unstable Material: Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenance structure.

1.2.7 Select Granular Material: Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough, and durable particles, and shall not contain more than 10 percent by weight of materials passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve, with a maximum allowable aggregate size of 3 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

1.2.8 Initial Backfill Material: Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

1.2.9 Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D418 or ASTM D 1557, Method C, abbreviated hereinafter as percent laboratory maximum density.

1.2.10 Spoil Areas: Spoil materials shall be disposed of in spoil areas located outside the limits of the site at the Contractor's expense and responsibility.

1.2.11 Selection of Borrow Material: Borrow material shall be selected to meet the backfill requirements and conditions for the particular area in which it is to be used. Approved borrow materials shall be obtained from borrow areas located outside the limits of the site at the Contractor's expense and responsibility. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Identified borrow sources are listed in Appendix B.

1.2.12 Plastic Marking Tape: Plastic marking tape shall be acid alkali-resistant polyethylene film, 6 inches wide with a minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from erosion. Tape color shall be as specified in Table 1 and shall bear a continuous printed inscription describing the specific utility.

Table 1 - Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Material
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

1.3 GENERAL QUALITY CONTROL TESTING

General quality control testing shall be the responsibility of the contractor and shall be performed at no additional cost to the Government. Quality control sampling and testing during construction shall be performed as required in paragraph TESTING.

1.4 SUBMITTALS

Copies of all laboratory and field test reports shall be submitted to the Contracting Officer within 24 hours of the completion of the test.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.1 EXCAVATION

Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides or cave-ins. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsatisfactory excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material, if directed, shall be removed and replaced with satisfactory on-site or imported material from approved sources at the cost of the Contractor. Excavated material not required or satisfactory for backfill shall be removed and disposed of as indicated in paragraph SPOIL AREAS. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at the cost of the Contractor. Blasting will not be permitted.

3.1.1 Trench Excavation: The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below and above the top of the pipe shall be sloped, or made vertical, as recommended in the manufacturer's installation manual. The trench width below the top of the pipe shall not exceed that recommended in the installation manual. Where no manufacturer's installation manuals are available, trench walls below the top of the pipe shall be vertical, and trench walls above the top of the pipe shall be sloped as required to properly complete the work. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 4 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. Trench width below the top of the pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24-inch inside diameter, and shall not exceed 36 inches plus pipe O.D. for larger sizes. Where recommended trench widths are exceeded, redesign shall be performed by the Contractor using stronger pipe or special installation procedures. The cost of this redesign and the increased cost of pipe or installation procedures shall be borne by the Contractor.

3.1.1.1 Bottom Preparation: The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material: Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with satisfactory materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material: Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor at his expense.

3.1.1.4 Removal of Unsatisfactory Material: Unsatisfactory material encountered beyond the depths indicated shall be removed and replaced with satisfactory material as directed. Determination of elevation of approved overdepth excavations shall be done in the presence of the Contracting Officer.

3.1.2 Shoring: Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.1.3 Jacking, Boring, and Tunneling: Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly tamped in such sections.

3.1.4 Opening and Drainage of Borrow Pits: Except as otherwise permitted, borrow pits shall be excavated in such manner as will afford adequate drainage. Overburden and other spoil material shall be disposed of as indicated in paragraph SPOIL AREAS. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall insure that excavation of borrow pits results in minimum detrimental effects on natural environmental conditions.

3.1.5 Dewatering: The Contractor shall note the subsurface water level recorded and date when this level was recorded on the boring logs shown on the contract documents. These water levels are only for the dates shown on the logs and it can be expected that

the water table may fluctuate to some extent. During construction, special care shall be taken to insure that excavation for trenches and drainage structures are accurate and no excavation for trenches and drainage structures, which will be influenced by groundwater, shall be made to final grade until dewatering has been accomplished to the satisfaction of the Contracting Officer. Excavation for trenches and drainage structures shall be performed so that the excavation will be continually and effectively drained. Water shall not be permitted to accumulate in any excavation. The excavation shall be drained by pumping or other satisfactory methods to prevent softening of the bottom, undercutting, or other actions detrimental to proper construction procedures. Prior to dewatering, the Contractor shall submit his dewatering plan to the Contracting Officer for review.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand-operated machines, unless otherwise specified. Material shall be moistened or aerated as necessary to provide the moisture content to within plus or minus 2% of optimum moisture content as determined from laboratory tests. Each layer shall be compacted to at least 95 percent laboratory maximum density for cohesionless soils and 90 percent laboratory maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill: Trenches shall be backfilled to the grade shown. The trench shall not be backfilled until all specified tests are performed.

3.2.1.1 Replacement of Unyielding Material: Unyielding material removed from the bottom of the trench shall be replaced with satisfactory material.

3.2.1.2 Replacement of Unstable Material: Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Replacement of Unsatisfactory Material: Unsatisfactory material removed from the subgrade of the trench shall be replaced with satisfactory material placed in layers not exceeding 8 inches loose thickness and compacted to a minimum of 90 percent laboratory maximum density for cohesive soils and 95 percent laboratory maximum density for cohesionless soils.

3.2.1.4 Initial Backfill: Initial backfill material shall be placed in layers of a maximum of 6 inches loose thickness and compacted with approved tampers to the density of the adjacent soil and to a height of at least 1 foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of pipe for the full length of the pipe. Care shall be taken to insure thorough compaction of the fill under the haunches of

the pipe. Backfill material in this portion of the trench shall consist of satisfactory material at a moisture content that will facilitate compaction, free from stones of such size as recommended by the pipe manufacturer.

3.2.1.5 Final Backfill: The remainder of the trench, except for special materials for roadways, shall be backfilled with satisfactory material. Backfill material shall be deposited and compacted as follows:

3.2.1.5.1 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to 85 percent laboratory maximum density for cohesive soils and 90 percent laboratory maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution: Trenches shall be excavated to a depth that will provide not less than 18 inches of cover in rock excavation and not less than 24 inches of cover in other excavation.

3.3.2 Water Supply: Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.3 Heat Distribution System: Initial backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.3.4 Electrical Distribution System: Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated.

3.3.5 Plastic Marking Tape: Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at the cost of the Contractor.

3.4.1 Soils Testing: Density tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. Approval of testing facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers to insure that the specified density is being obtained. Laboratory tests for moisture-density relations shall be determined in accordance with ASTM D 1557, Method C or AASHTO T 180, Method D. A mechanical tamper may be used, provided the results are correlated with those obtained by the referenced hand tamper or AASHTO T 180, Method D. Field in-place density shall be determined in accordance with AASHTO T 191, AASHTO T 238, ASTM D 1556, or ASTM D 2922. When AASHTO T 238 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in AASHTO T 191. AASHTO T 238 or ASTM D 2922 results in a wet unit weight of soil and when using this method, AASHTO T 239 or ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gages shall be checked along with the density calibration checks as described in AASHTO T 239 or ASTM D 3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves and results of calibration tests shall be furnished to the Contracting Officer within 24 hours of conclusion of tests. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government. Sieve analysis shall be performed in accordance with ASTM C 117, C 136, and D 422; sieves shall conform to ASTM E 11; and liquid limit and plasticity index determinations shall be performed in accordance with ASTM D 4318. Copies of test results shall be furnished to the Contracting Officer. The following minimum testing is required:

3.4.1.1 Fill, Backfill, and Existing Subgrade Materials (for each classification of material used):

3.4.1.1.1 Subgrade: One sieve analysis and one liquid limit and plasticity index determination for cohesive soils per 250 L.F. or fraction thereof of trench.

3.4.1.1.2 Fill and Backfill Material: One sieve analysis and one liquid limit and plasticity index determination for cohesive soils per 100 c.y. or fraction thereof.

3.4.1.1.3 Moisture Contents: A minimum of one test per 100 L.F. or fraction thereof of the trench subgrade prior to placement of fill or backfill thereon during stable weather conditions. In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, tests shall be made as directed by local conditions and approved by the Contracting Officer.

3.4.1.1.4 Optimum Moisture and Laboratory Maximum Density: One moisture-density curve to determine the optimum moisture content and the laboratory maximum density values shall be done for each type of subgrade material and one curve shall be done per 100 c.y. of each type of fill and backfill materials, to include any borrow materials.

3.4.1.1.5 Additional gradation, liquid limit, plasticity index determinations and moisture-density curves shall be required if there if any changes in gradation or particle shape or when any change occurs in the material which may affect the optimum moisture content or laboratory maximum density.

3.4.1.2 Field Density Tests

3.4.1.2.1 Subgrade

3.4.1.2.1.1 Trenches Under Pavements: One per 20 L.F. or fraction thereof of trench per pavement.

3.4.1.2.1.2 Adjacent to Utility and Drainage Structures Abutting Pavements: One per structure.

3.4.1.2.2 Backfill Material

3.4.1.2.2.1 Trenches Under Pavements: One per lift per 20 L.F. or fraction thereof of trench per pavement.

3.4.1.2.2.2 Trenches in Other Areas: One per 24 inches of compacted thickness or fraction thereof per 100 L.F. or fraction thereof of trench.

3.4.1.2.2.3 Utility and Drainage Structures which Abut a Pavement: One per 12 inches of compacted thickness or fraction thereof per structure.

3.4.1.2.3 Check Tests on In-Place Densities: If AASHTO T 238 or ASTM D 2922 is used, in-place densities shall be checked by AASHTO T 191 or ASTM D 1556, as follows:

3.4.1.2.3.1 Subgrade

3.4.1.2.3.1.1 Trenches Under Pavements: One check test per 20 L.F. or fraction thereof of trench per pavement.

3.4.1.2.3.1.2 Adjacent to Utility and Drainage Structures Abutting Pavements: One check test per structure.

3.4.1.2.3.2 Backfill Material

3.4.1.2.3.2.1 Trenches Under Pavements: One check test per lift per 20 L.F. or fraction thereof of trench per pavement.

3.4.1.2.3.2.2 Trenches in Other Areas: One check test per 24 inches of compacted thickness or fraction thereof per 100 L.F. or fraction thereof of trench.

3.4.1.2.3.2.3 Utility and Drainage Structures which Abut a Pavement: One check test per 12 inches of compacted thickness or fraction thereof per structure.

3.4.1.3 Location of tests shall be at the direction of the Contracting Officer.

3.4.2 Displacement of Sewers: After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light laser between manholes or manhole locations, or by use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alinement or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

END OF SECTION

SECTION 02411

METAL SHEET PILING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 328	(1989) Steel Sheet Piling
ASTM A 572	(1988c) High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 690	(1989) High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
ASTM A 857	(1989) Steel Sheet Piling, Cold-Formed, Light Gage
ASTM B 221	(1990a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 308	(1990a) Aluminum-Alloy 6061-T6 Standard Structural Shapes

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300, SUBMITTAL DESCRIPTIONS:

1.2.1 Metal Sheet Piling

Detail drawings for sheet piling including fabricated sections shall show complete piling dimensions and details, driving sequence and location of installed piling. Detail drawings shall include details and dimensions of templates and other temporary guide structures for installing piling. Detail drawings shall provide details of the method of handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

1.2.2 Pile Driving Equipment

Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval prior to commencement of work.

1.2.3 Pulling and Redriving

The proposed method of pulling sheet piling shall be submitted and approved prior to pulling any piling.

1.2.4 Interlocked Joint Strength in Tension Test

The procedure for testing sheet piling interlocked joint strength in tension shall be submitted and approved prior to testing piling.

1.2.5 Materials Tests

Certified materials tests reports showing that sheet piling and appurtenant metal materials meet the specified requirements shall be submitted for each shipment and identified with specific lots prior to installing materials.

1.2.6 Driving

Records of the sheet piling driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling. The format for driving records shall be as directed by the Contracting Officer.

1.3 DELIVERY, STORAGE AND HANDLING

Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling as required by the referenced specifications. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate required inspection activities. Sheet piling over 80 feet in length shall be handled using a minimum of two pickup points.

PART 2 PRODUCTS

2.1 METAL SHEET PILING

Sheet piling shall be hot-rolled steel sections conforming to ASTM A 328, interlocked joint strength in tension as shown on the drawings. The interlocks of sheet piling shall be free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed. Sheet piling including special fabricated sections shall be full-length sections of the dimensions shown on the drawings. Fabricated sections shall conform to the requirements herein and the piling manufacturer's recommendations for fabricated sections. Fabricated tees, wyres and cross pieces shall be fabricated of piling sections with a minimum web thickness of 1/2 inch.

2.2 APPURTENANT METAL MATERIALS

Metal plates, shapes, bolts, nuts, rivets and other appurtenant fabrication and installation materials shall conform to manufacturer's standards and to the requirements specified in the respective sheet piling standards.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

Requirements for material tests, workmanship and other measures for quality assurance shall be as specified herein.

2.3.1 Materials Tests

Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations.

2.3.2 Interlocked Joint Strength in Tension Test

The interlocked strength in tension test shall conform to the piling manufacturer's standard test, include testing at least two 3-inch long coupons taken randomly from different as-produced pilings of each heat and must be approved by the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Pile Driving Equipment

3.1.1.1 Driving Hammers

Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type. The driving energy of the hammers shall be specified by the manufacturer for the piling weights and subsurface materials to be encountered.

3.1.2 Placing and Driving

3.1.2.1 Placing

Any excavation required within the area where sheet pilings are to be installed shall be completed prior to placing sheet pilings. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/8 inch per foot of length and true to line. Temporary wales, templates, or guide structures shall be provided to insure that the pilings are placed and driven to the correct alignment. At least two templates shall be used in placing each piling and the maximum spacing of templates shall not exceed 20 feet. Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.

3.1.2.2 Driving

Pilings shall be driven with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths. Driving hammers shall be maintained in proper alignment during driving operations by use of leads or guides attached to the hammer. Caution shall be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock-melt or damages. The use of vibratory hammers should be discontinued and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute. A protecting cap shall be employed in driving when using impact hammers to prevent damage to the tops of pilings. Pilings damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense. Pilings shall be driven without the aid of a water jet. Adequate precautions shall be taken to insure that pilings are driven plumb. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall the piling being driven pilings shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding pilings. The maximum

permissible taper for any tapered piling shall be 1/8 inch per foot of length. Pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling. If obstructions restrict driving a piling to the specified penetration the obstructions shall be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical the Contractor shall make changes in the design alignment of the piling structure as directed by the Contracting Officer to insure the adequacy and stability of the structure. Pilings shall be driven to depths shown on the drawings and shall extend up to the elevation indicated on the drawings for the top of pilings.

3.1.3 Cutting-Off and Splicing

Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed by the Contracting Officer at no additional cost to the Government. If directed by the Contracting Officer pilings shall be spliced as required to drive them to depths greater than shown on the drawings and extend them up to the required top elevation. Pilings adjoining spliced pilings shall be full length unless otherwise approved. Splicing of pilings shall be as indicated on the drawings. Ends of pilings to be spliced shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. The tops of pilings excessively battered during driving shall be trimmed when directed at no cost to the Government. Piling cut-offs shall become the property of the Contractor and shall be removed from the site. The Contractor shall cut holes in pilings for bolts, rods, drains or utilities as shown on the drawings or as directed.

All cutting shall be done in a neat and workmanlike manner. A straight edge shall be used in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes shall be reasonably smooth and the proper size for rods and other items to be inserted.

3.1.4 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at the Contractor's expense.

3.1.5 Pulling and Redriving

The Contractor shall pull selected pilings after driving to determine the condition of the underground portions of pilings when directed by the Contracting Officer. Any piling so pulled and found to be damaged to the extent that its usefulness in the structure is impaired shall be removed and replaced at the Contractor's expense. Pilings pulled and found to be in satisfactory condition shall be redriven when directed by the Contracting Officer.

3.2 REMOVAL

The removal of sheet pilings shall consist of pulling, sorting, cleaning the interlocks, inventorying and storing previously installed sheet pilings as shown on the drawings and directed by the Contracting Officer.

3.2.1 Pulling

The method of pulling piling must be approved by the Contracting Officer. Pulling holes shall be provided in pilings as required. Extractors shall be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Contracting Officer determines that adjacent permanent construction has been damaged during pulling the Contractor will be required to repair this construction at no cost to the Government. Pilings shall be pulled one sheet at a time. Pilings fused together shall be separated prior to pulling unless the Contractor demonstrates to the satisfaction of the Contracting Officer that the pilings cannot be separated. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

3.2.2 Sorting, Cleaning, Inventorying and Storing

Pulled pilings shall be sorted, cleaned, inventoried and stored by type into groups as:

- a. Piling usable without reconditioning.
- b. Piling requiring reconditioning.
- c. Piling damaged beyond structural use.

3.3 QUANTITIES

The estimated quantities of sheet piling listed in the unit price schedule of the contract as to be furnished by the Contractor are given for bidding purposes only. Sheet piling quantities for payment shall consist of the linear feet of piling acceptably installed and removed. Installed quantities shall consist of all piling including fabricated sections driven

between the required top and bottom elevations of pilings plus any additions thereto resulting from changes in design or alignment as provided in paragraph "Driving." Removed quantities shall consist of the lengths of piling pulled from below the ground level.

(Quantities will be provided, when required)

END OF SECTION

JANUARY 1994

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SECTION 02511A
CONCRETE SIDEWALKS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94	(1990) Ready-Mixed Concrete
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 309	(1989) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

CORPS OF ENGINEERS (COE)

COE CRD-C 527	(1988) Standard Specification for Joint Sealants, Cold-Applied, Non-Jet-Fuel-Resistant, for Rigid and Flexible Pavements
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FEDERAL SPECIFICATIONS (FS)

FS SS-S-1401	(Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements
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1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

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02511A-1

03886-076-008

AR302682

1.2.1 Concrete

Copies of certified delivery tickets for all concrete used in the construction.

1.3 WEATHER LIMITATIONS

Concrete placement shall be discontinued when the air temperature is below 40 degrees F and is falling.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

PART 2 PRODUCTS

2.1 CONCRETE

ASTM C 94, cement type I. Alkali content of cement shall not exceed 0.6 percent. Only one brand of any one type of cement shall be used for exposed concrete surfaces of any individual structure. Concrete mixes shall be proportioned to obtain compressive strength in 28 days of 3000 psi. The compressive strength shall be reached in 7 days when high-early-strength cement is used. The maximum size of aggregate shall be 1-1/2 inches. Total air content of exterior concrete shall be maintained at 5 to 7 percent by volume of concrete. Slump shall be not more than 3 inches as determined by ASTM C 143.

2.2 CURING MATERIALS

Impervious sheet or membrane-forming curing compound. Impervious sheet shall be white opaque polyethylene 4 mil thick, waterproof kraft paper, or polyethylene-coated burlap. Membrane-forming curing compound shall be white pigmented and shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Linseed oil mixture shall be equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

Expansion joint filler shall be premolded, nonextruding type for use in concrete conforming to ASTM D 1751 or ASTM D 1752, 3/8-inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to FS SS-S-1401.

2.6 FORM WORK

Form work shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of a height equal to the full depth of the finished sidewalk.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted to conform with applicable requirements of Section 02201, EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall have a transverse slope of 1/4-inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer of such thickness that when consolidated and finished the sidewalks will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a wood float, bull float, or darby, edged and broom finished.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 0.25 inch.

3.4 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement.

3.4.1 Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness.

3.4.2 Expansion Joints

Expansion joints shall be formed with 1/2-inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be carefully cleaned and filled with joint sealer. Concrete at the joint shall be surface dry and the atmospheric and pavement temperatures shall be above 50 degrees F at the time of application of joint-sealing materials. Joints shall be filled with sealer flush with the concrete surface in such manner as to minimize spilling on the walk surface. Spilled sealing material shall be removed immediately and the surface of the walk cleaned.

3.5 CURING AND PROTECTION

3.5.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period. Membrane forming curing compound shall be applied in accordance with the manufacturer's recommendations.

3.5.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.5.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction.

3.5.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to exposed-to-view concrete surfaces.

3.5.4.1 Application

Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and thoroughly clean before each application. Coverage shall be not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.5.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F.

3.6 SURFACE DEFICIENCIES AND CORRECTIONS

Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which exceed plan grade, surface smoothness, or thickness tolerances shall be corrected as directed by the Contracting Officer.

END OF SECTION

SECTION 02511B

CONCRETE CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1990a) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	(1990) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616	(1990) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617	(1990) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 94	(1990) Ready-Mixed Concrete
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 309	(1989) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

CORPS OF ENGINEERS (COE)

COE CRD-C 527	(1988) Standard Specification for Joint Sealants, Cold-Applied, Non-Jet-Fuel-Resistant, for Rigid and Flexible Pavements
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FEDERAL SPECIFICATIONS (FS)

FS SS-S-1401

(Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.2.1 Concrete

Copies of certified delivery tickets for all concrete used in the construction.

1.3 WEATHER LIMITATIONS

Concrete shall not be placed when the air temperature is below 40 degrees F and is falling.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. Straightedge shall have handles to facilitate movement on the concrete surface.

1.4.2 Curb Forming Machine

Curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

PART 2 PRODUCTS

2.1 CONCRETE

ASTM C 94, cement type I. Alkali content of cement shall not exceed 0.6 percent. Only one brand of any one type of cement shall be used for exposed concrete surfaces of any individual structure. Concrete mixes shall be proportioned to obtain compressive strength in 28 days of 3000 psi. The compressive strength shall be reached in 7 days when high-early-strength cement is used. The maximum size of aggregate shall be 1-1/2 inches.

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AR302689

Total air content of exterior concrete shall be maintained at 5 to 7 percent by volume of concrete. Slump shall be not more than 3 inches as determined by ASTM C 143.

2.2 CURING MATERIALS

Impervious sheet or membrane-forming curing compound. Impervious sheet shall be white opaque polyethylene 4 mil thick, waterproof kraft paper, or polyethylene-coated burlap. Membrane-forming curing compound shall be white pigmented and shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Linseed oil mixture shall be equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used except that emulsified mixtures are not acceptable.

2.4 REINFORCEMENT STEEL

Reinforcement bars shall conform to ASTM A 615, ASTM A 616, or ASTM A 617. Wire mesh reinforcement shall conform to ASTM A 185.

2.5 JOINT FILLER STRIPS

2.5.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.5.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 1/2-inch thick, unless otherwise indicated.

2.6 JOINT SEALANTS

2.6.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

2.6.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to FS SS-S-1401.

2.7 FORM WORK

Form work shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted to conform with applicable requirements of Section 02210, GRADING AND SITE RESTORATION. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators.

3.3.2 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The

front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.3.3 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 0.25 inch.

3.4 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.4.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8-inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.4.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2-inch in width shall be provided at intervals not exceeding 30 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated.

Expansion joints and the top 1-inch depth of curb and gutter contraction-joints shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5 CURING AND PROTECTION

3.5.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period. Membrane forming curing compound shall be applied in accordance with the manufacturer's recommendations.

3.5.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.5.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction.

3.5.4 Protective Coating

Protective coating of linseed oil shall be applied to exposed-to-view concrete surfaces.

3.5.4.1 Application

Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and thoroughly clean before each application. Coverage shall be not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.5.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F.

3.6 SURFACE DEFICIENCIES AND CORRECTIONS

Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which exceed plan grade, surface smoothness, or thickness tolerances shall be corrected as directed by the Contracting Officer.

END OF SECTION

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SECTION 02551

BITUMINOUS PAVING FOR ROADS, STREETS, AND OPEN STORAGE AREAS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1990) Materials Finer than 75-micrometer (No 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1988) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1984a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183	(1988) Sampling and the Amount of Testing of Hydraulic Cement
ASTM D 5	(1986) Penetration of Bituminous Materials
ASTM D 75	(1987) Sampling Aggregates
ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 242	(1985; R 1990) Mineral Filler for Bituminous Paving Mixtures
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils

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ASTM D 946	(1982) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 1250	(1980; R 1990) Petroleum Measurement Tables
ASTM D 1856	(1979; R 1984) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1991) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1992) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1990) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 3381	(1983) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3515	(1989) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 4791	(1989) Flat or Elongated Particles in Coarse Aggregate

MILITARY STANDARDS (MIL-STD)

MIL-STD 620	(Rev A; Notice 1) Test Methods for Bituminous Paving Materials
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300, SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Bituminous Pavement

Copies of test results.

SD-18 Records

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Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work.

1.3 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.3.1 General

The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures.

1.3.2 Mixing Plants

The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

1.3.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 12-foot straightedge for each bituminous paver. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.4 WEATHER LIMITATIONS

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 40 degrees F.

1.5 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

1.6 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

1.6.1 Plan Grade

The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

1.6.2 Surface Smoothness

When a 12-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 1/4 inch from the straightedge.

1.7 GRADE CONTROL

Lines and grades shall be established and maintained at site of work by the Contractor. Finished pavement elevations shall be established and controlled at the site of work by the Contractor.

1.7.1 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by the Contracting Officer.

1.8 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of the mixtures.

1.9 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for the bituminous mixture actually used in construction.

PART 2 PRODUCTS

2.1 BITUMINOUS HOT MIX

Shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the qualities and in the proportions specified and shall conform to the requirements contained in paragraphs PROPORTIONING OF MIXTURE and ACCEPTABILITY OF WORK.

2.1.1 Aggregates

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screening, sand, and mineral filler, as required. The portion of materials retained on the No. 4 sieve shall be known as coarse aggregate, the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate, and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in TABLE I. TABLE I is based on aggregates of uniform specific gravity; the percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentage passing various sieves may be changed by the Contracting Officer when aggregates vary by more than 0.2 in specific gravity.

TABLE I. AGGREGATE GRADATION

Sieve Size	Wearing Course, Percent Passing	Intermediate Course, Percent Passing
No. 4	8	8

2.1.1.1 Coarse Aggregate

Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

- Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.
- The dry weight of crushed slag shall not be less than 75 pcf, as determined in accordance with ASTM C 29.
- Crushed gravel retained on the No. 4 sieve and each coarser sieve shall contain at least 75 percent by weight of crushed pieces having one or more fractured faces with the area of each face equal to at least 75 percent of the smallest midsectional area of piece.

When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as two fractured faces.

d. Particle shape of crushed aggregates shall be essentially cubical. The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with ASTM D 4791.

2.1.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles including natural sand or crushed stone, slag, or gravel that meets requirements for wear and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve. This requirement shall apply to the material before blending with natural sand when blending is necessary. Quantity of natural sand to be added to the wearing- and intermediate-course mixtures shall not exceed 25 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter.

2.1.1.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

Grain size in mm	Percent Finer
0.05	70-100
0.02	35-65
0.005	10-22

2.1.2 Bituminous Material

Asphalt cement shall conform to ASTM D 946.

2.1.3 Additives

The use of additives such as antistripping and antifoaming agents is subject to approval.

2.2 PROPORTIONING OF MIXTURE

2.2.1 Job Mix Formula

The formula will indicate the percentage of each stockpile and mineral filler, the percentage of each size aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. Tolerances are given in TABLE

It for asphalt content, temperature, and aggregate grading for tests conducted on the mix as discharged from the mixing plant; however, the final evaluation of aggregate gradation and asphalt content will be based on paragraph ACCEPTABILITY OF WORK. Bituminous mix that deviates more than 25 degrees F from the JMF (Job Mix Formula) shall be rejected. The JMF may be adjusted during construction to improve paving mixtures, as directed, without adjustments in the contract unit prices.

TABLE II. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	4 percent
Aggregate passing Nos. 100 and 200 sieves	2 percent
Bitumen	0.25 percent
Temperature of mixing	25 degrees F

2.2.2 Test Properties of Bituminous Mixtures

Finished mixture shall meet requirements described below when tested in accordance with MIL-STD 620, Method 100.

2.2.2.1 Stability, Flow, and Voids

Requirements for stability, flow, and voids are shown in TABLES III and IV for nonabsorptive and absorptive aggregates, respectively.

TABLE III. NONABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
Stability minimum, pounds	500	500
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	3-5	4-6
Voids filled with bitumen, percent (2)	75-85	65-75

(1) The Contracting Officer may permit deviations from limits specified.

TABLE IV. ABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
Stability minimum, pounds	500	500
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	2-4	3-5
Voids filled with bitumen, percent (2)	80-90	70-80

(1) The Contracting Officer may permit deviations from limits specified.

a. When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet requirements in TABLE III.

b. When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in MIL-STD 620, Method 105, or ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in TABLE IV.

2.2.2.2 Stability

The index of retained stability must be greater than 75 percent as determined by MIL-STD 620, Method 104.

PART 3 EXECUTION

3.1 BASE COURSE CONDITIONING

The surface of the base course will be inspected for adequate compaction and surface tolerances. Unsatisfactory areas shall be corrected.

3.2 PREPARATION OF BITUMINOUS MIXTURES

Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate

with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

3.3 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with ASTM D 2216; the weight of the sample shall be at least 500 grams. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

3.4 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

3.5 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of the intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

3.6 TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material.

3.7 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided.

3.7.1 Handspreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

3.8 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness will be checked in each lot of completed pavement by the Contracting Officer for compliance and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. After the Contractor is assured of meeting crown, grade, and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

3.8.1 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous tack coat. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein.

3.9 JOINTS

3.9.1 General

Joints shall be made to insure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of Bituminous tack coat. Material shall

be applied far enough in of placement of a fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

3.10 ACCEPTABILITY OF WORK

3.10.1 General

A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements.

3.10.2 Optional Sampling and Testing

The Contracting Officer reserves the right to sample and test any area which appears to deviate from the specification requirements.

3.10.2 Lot Density

All density results on a lot will be completed and reported within 24 hours after construction of that lot. The Contractor shall fill all sample holes with hot mix and compact.

3.10.3 Grade

Grade-conformance tests will be conducted by the Government. The finished surface of the pavement will be tested for conformance with plan-grade requirements. Within 5 working days after completion of placement of a particular lot, the Contracting Officer will inform the Contractor in writing of results of grade-conformance tests. In areas where the grade exceeds the plan-grade tolerances given by more than 50 percent, the Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed.

3.10.4 Surface Smoothness

After completion of final rolling of a lot, the compacted surface will be tested by the Contracting Officer with a 12-foot straightedge. Any joint or mat area surface deviation which exceeds the tolerance given by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed.

END OF SECTION

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SECTION 02552

REPLACEMENT OF BITUMINOUS PAVING

1.0 APPLICABLE PUBLICATION: Commonwealth of Pennsylvania, Department of Transportation Specifications, 1990, and addendum thereto, referred to herein as PADOT specifications.

1.1 Reference to "Engineer" shall be interpreted to mean "Contracting Officer Representative (COR)."

1.2 Delete all references to MEASUREMENT and PAYMENT paragraphs.

1.3 All testing shall be done by an independent commercial testing laboratory at the Contractor's expense and responsibility.

2.0 MATERIALS

2.1 Bituminous Surface Course: The surface course shall conform to the requirements of Section 420, Bituminous Wearing Course, ID-2 of the PADOT specifications, except as modified herein.

2.2 Bituminous Binder Course: The binder course shall conform to the requirements of Section 421, Bituminous Binder Course, ID-2 of the PADOT specifications, except as modified herein.

2.3 "Wearing course" shall be construed to mean "surface course".

2.4 Item 401.2(d) - Composition of Mixture

2.4.1 The establishment of the job-mix formula and the plant control shall be performed by an independent recognized commercial testing laboratory at the Contractor's expense and responsibility. The finished mixture shall meet the requirements described below when tested in accordance with MIL-STD-620A, TEST METHODS FOR BITUMINOUS PAVING MATERIALS.

Test Property	Surface Course	Binder Course
Stability, minimum, pounds	1200	1000
Flow, maximum, 1/100 inch units	16	16
Voids, total mix, percent	3-5	3-5
Voids filled with bitumen, percent	75-85	65-75

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The Contractor shall submit the mix design accompanied by test results attesting that the materials and properties selected shall produce a mixture of the specified qualities.

2.4.2 Hot-bin gradations shall be performed at a minimum of two-hour intervals and the composite gradation shall be calculated from the gradation of each hot bin. Based on these analyses, suitable adjustments shall be made to conform to the approved job-mix formula.

2.4.3 A minimum of three Marshall specimens shall be molded per 500 square yards of material placed or fraction thereof. Specimens shall be tested in accordance with MIL-STD-620A, Method 100, and the results furnished the Contracting Officer 24 hours after completion of the testing.

2.5 Item 401.3(f) - Preparation of Existing Surface

2.5.1 A prime coat meeting the requirements of Section 461 shall be applied to all areas indicated on the drawings or directed by the COR. Application rates shall range from 0.20 to 0.50 gallon per square yard. The actual application rate shall be determined by the COR from the results of a trial strip. The prime coat shall be permitted to cure for a period of 48 hours or longer, as required by the COR. The primed surface shall not be left uncovered long enough to permit it to lose its tackiness.

2.5.2 A tack coat meeting the requirements of Section 460 shall be applied to all areas indicated on the drawings or directed by the COR. Surfaces to receive a tack coat shall be free of excess dust and other loose material. Application rates shall range from 0.05 to 0.20 gallon per square yard. The actual application rate shall be determined by the COR from the results of a trial strip. Work shall be planned so that no more tack coat than is necessary for the day's operation is placed on the surface. The tack coat shall be permitted to cure until the proper degree of tackiness, as determined by the COR, has been obtained.

2.6 Item 401.3(i) - Density Acceptance: Samples for determining pavement densities shall be taken with a coring machine or by cutting a 6-inch square out of the pavement. One set (three samples) shall be taken for every 500 square yards of material placed. Density samples of the day's production shall be taken and tested by noon of the following day and the results submitted to the COR within 24 hours after completion of the testing. The bituminous course shall be compacted to not less than 95% of the laboratory maximum density.

3.0 GRANULAR BASE AND SUBBASE COURSE shall conform to the requirements of Section 350, SUBBASE. Material shall be Type B or better and conform to gradation No. 2A, as specified in Tables B and C of Section 703.2 Coarse Aggregate of the Pennsylvania Specifications. The Contractor shall submit to the COR the results of gradation, liquid limit, plasticity index, wear, soundness, and laboratory moisture-density

curves for each source of base course material. A minimum of one in-place density tests shall be performed per (50) (100) linear feet or fraction thereof of trench per pavement and the test results submitted to the COR.

4.0 EARTHWORK AND SUBGRADE PREPARATION shall conform to SECTION 02201, EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS and Section 02221, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

END OF SECTION

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SECTION 02660A
WATER SERVICE LINES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

- | | |
|--------------|---|
| ANSI B1.20.1 | (1983) Pipe Threads, General Purpose (Inch) |
| ANSI B16.1 | (1975) Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800 |
| ANSI B16.3 | (1985) Malleable-Iron Threaded Fittings, Classes 150 and 300 |
| ANSI B16.26 | (1983) Cast Copper Alloy Fittings for Flared Copper Tubes |

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

- | | |
|---------|--|
| AREA-03 | (1988) Manual for Railway Engineering (Fixed Properties): Chapter 1, Roadway and Ballast |
|---------|--|

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|---|
| ASTM A 53 | (1988 Rev. a) Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless |
| ASTM B 88 | (1988 Rev. a) Seamless Copper Water Tube |
| ASTM D 1784 | (1981) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D 1785 | (1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D 2241 | (1988) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |

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ASTM D 2464	(1988) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1988) Pocket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1988) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D 2657	(1987) Heat-Joining Polyolefin Pipe and Fittings
ASTM D 2855	(1983) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM F 477	(1976; R 1985) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1987) Hypochlorites
AWWA B301	(1987) Liquid Chlorine
AWWA C104	(1985) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1987) Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids
AWWA C111	(1985) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C153	(1988) Ductile-Iron Compact Fitting, 3 In. through 6 In. for Water and Other Liquids
AWWA C203	(1986) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape-Hot-Applied
AWWA C207	(1986) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In.

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AWWA C504	(1980) Rubber-Seated Butterfly Valves
AWWA C603	(1987) Installation of Asbestos-Cement Pressure Pipe
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1986) Disinfecting Water Mains
AWWA C700	(1977) Cold Water Meters--Displacement Type
AWWA C701	(1978) Cold Water Meters--Turbine Type for Customer Service
AWWA C800	(1984) Underground Service Line Valves and Fittings
AWWA C900	(1981; Errata) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water
AWWA C901	(1988) Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 In. through 3 In., for Water
AWWA C902	(1988) Polybutylene (PB) Pressure Pipe, Tubing and Fittings, 1/2 In. through 3 In., for Water

MANUFACTURERS STANDARDIZATION SOCIETY OF THE
VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
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NATIONAL SANITATION FOUNDATION (NAF)

NSF Std 14	(Oct. 1965, Rev. thru Oct. 1987) Plastic Piping System Components and Related Materials
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1.2 GENERAL

This section covers water service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required.

1.2.1 Piping for Water Service Lines

Piping for water service lines less than 3 inches in diameter shall be galvanized steel, Polyvinyl Chloride (PVC) plastic, polyethylene, polybutylene, or copper tubing, unless otherwise shown or specified.

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1.2.2 Plastic Pipe

All thermoplastic piping system components (PVC, polyethylene and polybutylene) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

1.2.3 Excavation, Trenching, and Backfilling for Water Lines

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300, SUBMITTAL DESCRIPTIONS:

Upon completion of the project and before final acceptance, the Contractor shall deliver to the Contracting Officer a statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in complete accordance with the contract plans and specifications and the manufacturer's prescribed procedures and techniques.

The Contractor will maintain a chronological record throughout the course of the contract of all uncorrected deficiency items.

1.4 HANDLING

Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition.

PART 2 PRODUCTS

2.1 PIPE

2.1.1 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.1.2 Polyvinyl Chloride (PVC) Plastic Pipe

All pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Screw-Joint: Pipe to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, must be tested as required by ASTM D 2464.

b. Elastomeric-Gasket Joint: Pipe shall be to dimensional requirements of ASTM D 1785, Schedule 40 with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure	Minimum Hydrostatic Pressure
26	100	133
21	120	160
17	150	200
13.5	200	266

In addition to the above requirements, the pipe, couplings and fittings must be hydrostatically tested as required by AWWA C900, and must be to iron pipe (I.P.S.) or cast iron outside diameter (CIOD) size dimensions.

c. Solvent Cement Joint: Pipe to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

2.1.3 Galvanized-Steel Pipe, Less Than 3 Inches

Galvanized steel pipe, less than 3 inches in diameter shall conform to ASTM A 53, standard weight.

2.1.4 Protective Materials for Steel Pipe

Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. Steel pipe and fittings less than 3 inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

2.1.5 Polyethylene Plastic (PE)

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901 for pipe less than 3 inches in diameter.

2.1.6 Polybutylene Plastic (PB)

Pipe, tubing and fusion fittings shall conform to AWWA C902 for pipe less than 3 inches in diameter.

2.2 JOINTS

2.2.1 Copper Tubing

Joints shall be compression-pattern flared and shall be made with fittings hereinafter specified.

2.2.2 Polyvinyl Chloride Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

2.2.3 Polyethylene (PE) and Polybutylene (PB) Pipe

Joints for pipe fittings and coupling shall be strong pressure tight joints as specified for polyethylene and polybutylene pipe in paragraph "INSTALLATION." Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

2.2.4 Bonded Joints

Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond wire shall be Type RHW-USE, Size 1/0 neoprene-jacketed copper conductor shaped to stand clear of the joint. The bond shall be of the thermal weld type.

2.2.5 Insulating Joints

Insulating joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Insulating joints shall consist of a sandwich-type flange insulating gasket of the dielectric type, insulating washers, and insulating sleeves for flange bolts. Insulating gaskets shall be full faced with outside diameter equal to the flange outside

diameter. Bolt insulating sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.2.6 Connections

Connections between existing asbestos-cement pipe and cast-iron fittings, valves or hydrants shall be made with jointing materials conforming to AWWA C603.

2.3 FITTINGS AND SPECIALS

2.3.1 Copper Tubing

Fittings and specials shall be flared and conform to ANSI B16.26.

2.3.2 Ductile-Iron Pipe

Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard thickness. Ductile iron compact fittings shall be accordance with AWWA C153.

2.3.3 Polyvinyl Chloride (PVC) Pipe

For pipe less than 4-inch diameter, fittings for threaded pipe shall conform to the requirements of ASTM D 2464. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467. Fittings for elastomeric-gasket joint pipe shall be ductile iron conforming to AWWA C110 or AWWA C111.

2.3.4 Galvanized-Steel Pipe Less Than 3 Inches

Steel fittings shall be galvanized. Screwed fittings shall conform to ANSI B16.3. Flanged fittings shall conform to AWWA C207. Dresser-type fitting shall be suitable for use with type of pipe furnished.

2.3.5 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.4 MECHANICAL COUPLINGS

Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.5 VALVES

2.5.1 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI B16.1.

2.5.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

2.5.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 must be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.5.4 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 150 psi operating pressure on the inlet side, with outlet pressure as specified on the design drawings. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.5.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.6 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

2.7 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with Section 03300A, CONCRETE FOR BUILDING CONSTRUCTION.

2.8 MISCELLANEOUS ITEMS

2.8.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.8.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.8.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections be in accordance with standard practice.

2.8.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.8.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which

engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.8.6 Service Boxes

Service boxes shall be cast iron or concrete. Extension service boxes of the required length and having either screw or slide-type adjustment shall be installed at all service box locations. The boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers.

2.8.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.8.8 Meters

Meters shall be of the displacement type conforming to AWWA C700 or turbine type conforming to AWWA C701. Registers may be round or straight reading type. Connection to the water line shall be as required for the particular installation. All meters used for the same system shall be of one type and manufacturer.

2.8.9 Meter Boxes

Meter boxes shall be of cast iron or concrete of sufficient size to completely enclose the meter and shut-off valve or service stop. Box height shall extend from invert of the meter to final grade at the meter location. Cover shall be cast iron with the word "WATER" cast in it.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all

burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

3.1.2.5 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required for roads, railroads, and airfields. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure that there will be no damage to the structures and no settlement or movement of foundations or footings. Any damage occurring as a result of the Contractor's operation shall be corrected and all costs connected therewith shall be borne by the Contractor.

3.1.3 Joint Deflection

3.1.3.1 Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but in no case shall it exceed 5 degrees.

3.1.3.2 Steel Pipe

For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified hereinbefore.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joining is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. Standard methods are available for making connections to various types of pipe, either under pressure or in the dewatered condition. Where made under pressure, these connections shall be installed as approved by the Contracting Officer.

3.1.4.2 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.3 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Copper Tubing

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.2 Polyvinyl Chloride (PVC) Plastic Pipe

Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. Care shall be exercised to assure the gasket and ring groove in the bell or coupling match. The manufacturer of the pipe or fitting must also supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall utilize sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

3.1.5.3 Polyethylene (PE) and Polybutylene (PB) Pipe

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique III-Hot Gas Fusion. Technique II is not acceptable.

3.1.5.4 Galvanized-Steel Pipe

Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.1.5.5 Bonded Joints

Bonded joints shall be installed in accordance with details specified for joints under paragraph "MATERIALS."

3.1.5.6 Insulating Joints

Insulating joints shall be installed in accordance with details specified for joints under paragraph "MATERIALS."

3.1.5.7 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with extension service boxes of the lengths required. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 2 Inches and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

3.1.6.2 Connections to Asbestos-Cement Mains

Connections to Asbestos-Cement Mains: Couplings shall have factory threaded outlets. Threads may be either iron-pipe thread or AWWA type. A corporation stop and a gooseneck shall be provided with the connection. Maximum sizes for outlets shall be as follows:

Pipe Size Inches	Outlet Sizes Inches
3 and 4	3/4, 1, 1-1/4
6 and larger	3/4, 1, 1-1/4, 1-1/2

- (1) Service lines 1-1/2 inches and smaller shall have a service stop.
- (2) Service lines 2 inches in size shall have a gate valve.
- (3) Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Three-inch and larger lines may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.7 Field Coating and Lining of Galvanized-Steel Pipe

Field joints shall be given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to AWWA C203, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating required for the pipe.

3.1.8 Setting of Valves and Valve Boxes

3.1.8.1 Valves and Valve Boxes

Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.2 Valves

Valves after delivery shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the valve shall be fully opened and fully closed to insure that all parts are in working condition. Check valves, pressure reducing valves, vacuum, and air relief valves shall be installed in valve pits where shown.

3.1.8.3 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

- c. Maintaining the trench in an open condition would delay completion of the contract.
- d. An unforeseeable cause which would result in excess cost.

The Contractor may request the waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02221, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = 0.0001351 * N * D * (P^{0.5})$$

In which L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the formula above, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete reaction backing necessitates a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at his cost.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 DISINFECTION

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLETS

Corporation Pipe Size Inches	Stops, Inches For Ductile-Iron Pipe	Outlets w/Service	
		For Asbestos- Cement Pipe	Clamps, Inches Single & Double Strap
3	--	3/4	1
4	1	3/4	1
6	1-1/4	3/4	1-1/2
8	1-1/2	1	2
10	1-1/2	1	2
12 & larger	2	1	2

END OF SECTION

SECTION 02730A

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1987) Cast Iron Soil Pipe and Fittings
ASTM C 14	(1988) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 33	(1990) Concrete Aggregates
ASTM C 76	(1989) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 94	(1990) Ready-Mixed Concrete
ASTM C 150	(1989) Portland Cement
ASTM C 260	(1986) Specification for Air-Entraining Admixtures for Concrete
ASTM C 270	(1989) Mortar for Unit Masonry
ASTM C 700	(1989a) Vitriified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM D 2680	(1989) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1989) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1989) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

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ASTM D 3262	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Sewer Pipe
ASTM F 402	(1988) Safe Handling of Solvent Cements, Primers, and Cleaners, Used for Joining Thermoplastic Pipe and Fittings
ASTM F 794	(1989) Poly(Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1989a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1989) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

FEDERAL SPECIFICATIONS (FS)

FS QQ-C-40	(Basic; Am 2) Calking: Lead Wool and Lead Pig
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UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-9	(1990) Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)
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1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with existing sewer or with the building drains 5 feet outside the building to which the sewer system is to be connected. Excavation and backfilling shall conform to Section 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer.

1.3 SUBMITTALS (Not Applicable)

1.4 HANDLING AND STORAGE

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations.

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PART 2 PRODUCTS

2.1 PIPE

Pipe may be of any of the following materials unless otherwise specified or indicated. Fittings shall have strength not less than that of the pipe.

2.1.1 Fittings and Specials for Asbestos-Cement Pipe

Fittings and specials for use with existing asbestos-cement pipe shall be cast iron, bell end, conforming to ASTM A 74 except that profile of bell may have special dimensions as required by the pipe manufacturer.

2.1.2 Cast Iron Soil Pipe and Fittings

ASTM A 74, Class SV

2.1.2.1 Rubber Gaskets for Compression Joints

Standard commercial products.

2.1.2.2 Caulked Joints

a. Joint Packing Material: Twisted jute or oakum, tarred type. The packing shall contain no material that would coat the pipe so as to adversely affect adhesion of the joint sealing material to the pipe.

b. Lead: FS QQ-C-40.

2.1.3 Clay Pipe and Fittings

ASTM C 700; Compression joints shall be standard commercial products.

2.1.4 Concrete Pipe and Specials

Concrete pipe 24 inches or less in diameter, and specials, unless otherwise shown or specified, shall be nonreinforced and conform to ASTM C 14, Class 2. Concrete pipe greater than 24 inches in diameter, and specials, shall be reinforced and conform to ASTM C 76, Class 11. Pipe less than 36 inches in diameter shall be bell and spigot type. Pipe 36 inches or greater in diameter shall be bell and spigot type, tongue and groove type, or modified tongue and groove type.

Joints and gaskets shall be standard commercial products.

2.1.5 Plastic Pipe and Fittings

2.1.5.1 ABS and PVC Composite Pipe and Fittings

ASTM D 2680, Type SC or OR, Size 8-inch through 15-inch diameter.

2.1.5.2 ABS Pipe and Fittings

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 12 inches or less in diameter, dimensions and tolerances in accordance with Table 2 therein.

2.1.5.3 PVC Pipe and Fittings

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 15 inches or less in diameter, with flexible standard commercial elastomeric gasket joint. ASTM F 949 for corrugated sewer pipes with a smooth interior and fittings of 4, 6, 8, and 10 inches in diameter. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8-inch through 48-inch diameters.

2.1.5.4 High Density Polyethylene Pipe and Fittings Materials

ASTM F 894, Class 63, size 18-inch through 120-inch. Rubber gasket joints shall be standard commercial products.

2.1.5.5 Branch Connections

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall comply with Figure 2 of ASTM D 2680, saddles for ABS pipe shall comply with TABLE 3 of ASTM D 2751, and saddles for PVC pipe shall comply with TABLE 4 of ASTM D 3034.

2.1.5.6 Protection of Material

Plastic pipe and fittings shall be protected from exposure to sunlight and any environment that would result in damage or deterioration to the material. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation. Solvents shall be discarded when the recommended pot life is exceeded.

2.1.6 Fiberglass Pipe and Fittings

2.1.6.1 Reinforced Plastic Mortar Pipe and Fittings

ASTM D 3262

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a. Fittings: Compatible with the pipe supplied.

b. Joints: Joints shall be bell and spigot type utilizing a standard commercial elastomeric gasket.

2.1.6.2 Reinforced Thermosetting Resin Pipe and Fittings

ASTM D 3262.

a. Fittings: Compatible with the pipe supplied.

b. Joints: Joints shall be bell and spigot type utilizing a standard commercial elastomeric gasket.

2.2 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.3 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast-iron frames and covers shall be as indicated in all essentials of design as suitable for the application, circular, without vent holes. The letter "S," at least 2 inches high, shall be stamped or cast into all covers so as to be plainly visible. Reinforced concrete frames and covers shall be as indicated.

2.4 LADDERS FOR MANHOLES

Ladders for manholes shall be as indicated. The ladder and inserts shall be galvanized after fabrication.

2.5 PORTLAND CEMENT

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Where aggregates are alkali reactive, as determined in accordance with Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalis shall be used.

2.6 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to ASTM C 94, Class A compressive strength of 3750 psi at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.7 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS

Precast reinforced concrete manhole sections shall be standard commercial products. Joints shall be cement mortar, or an approved mastic or rubber gasket, or an approved combination of these types.

2.8 GLASS-FIBER-REINFORCED POLYESTER MANHOLES

Glass-fiber-reinforced polyester manholes shall be standard commercial products.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

3.1.1.2 Structures

Where sewer pipe is required to be installed within 3 feet of a building or structural foundation, the sewer pipe shall be sleeved as specified above. Care shall be exercised during installation to assure that there will be no damage to such structures. Any damage occurring as a result of the Contractor's operation shall be corrected and all costs connected therewith shall be borne by the Contractor.

3.1.2 Pipe Laying

- a. Pipe shall be protected during handling against impact shocks and free fall.
- b. Pipe laying shall proceed upgrade with the spigot ends or tongue ends pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted so as to obtain the degree of water tightness required.

d. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be installed in accordance with ASTM F 402, and all required precautions shall be taken to assure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space so as to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 1 inch after caulking.

3.1.2.2 Trenches

Trenches shall be kept dry during bedding, laying, and jointing. When work is not in progress, open ends of pipe and fittings shall be closed so that no water or other material will enter the pipe or fittings.

3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement.

3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install at no additional cost to the Government such concrete cradling, pipe encasement, or other bedding as may be required to satisfactorily support the added load of the backfill.

3.1.2.5 Joints

Joint installation shall comply with manufacturer's instructions.

3.1.3 Leakage Tests

Lines shall be tested for leakage by appropriate methods. Visible leaks encountered shall be corrected regardless of leakage test results. Leakage as measured by either the

infiltration test or exfiltration test shall not exceed 0.2 gallons per inch diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at the cost of the Contractor.

3.1.4 Deflection

Any pipe showing deflections in excess of 5 percent at the end of one year following installation and acceptance will be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated. Cutting into piping for connections shall not be done except in special approved cases. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer.

3.4 MANHOLES

3.4.1 General

Manholes shall be constructed as indicated. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction, size, and grade of the channels shall be made gradually and evenly. Pipe connections shall be made in accordance with the manufacturer's recommendation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels.

3.4.2 Jointing and Plastering

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer.

3.4.3 Frames and Covers

Unless otherwise indicated, the frames and covers shall be so set that the top of the cover will be flush with finished pavement grade or 2 inches higher than finished grade in unpaved areas.

END OF SECTION

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SECTION 02935

TURF

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Amended thru: Aug 1988) Federal Seed Act Regulations
(Part 201-202)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 977 (1986) Emulsified Asphalt

ASTM D 2028 (1976; R 1986) Cutback Asphalt (Rapid-Curing Type)

ASTM D 2607 (1969) Peats, Mosses, Humus, and Related Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 (Basic) Fertilizer

FEDERAL SPECIFICATIONS (FS)

FS JJJ-S-181 (Rev B) Seeds, Agricultural

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

Manufacturer's Literature

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material, and for chemical treatment material.

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Equipment List

A list of proposed pesticide application, seeding and mulching equipment to be used in performance of turfing operation, including descriptive data and calibration tests.

Delivery

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

Maintenance Report

Written record of maintenance work performed.

Turf Establishment Period

Written calendar time period for the turf establishment period. When there is more than one turf establishment period, the boundaries of the turfed area covered for each period shall be described.

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Certified copies of the reports for the following materials shall be included:

Seed

For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

Sod

For species, mixture percentage, percent purity, field location.

Sprigs

For cultivar, genetic purity, field location.

Fertilizer

For chemical analysis, composition percent.

Agricultural Limestone

For calcium carbonate equivalent and sieve analysis.

Peat

For compliance with ASTM D 2607.

Asphalt Adhesive

For compliance with ASTM D 977 and ASTM D 2028.

Topsoil

For pH, particle size, chemical analysis and mechanical analysis.

1.3 SOURCE INSPECTIONS

Sod material will be subject to inspection by the Contracting Officer at the growing site.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Protection

Sod shall be protected from drying out and contamination during delivery.

1.4.1.2 Topsoil

A soil test shall be provided for topsoil delivered to the site.

1.4.1.3 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.2 Inspection

Seed and sod shall be inspected upon arrival at the job site by the Contracting Officer for conformity to type and quality in accordance with paragraph MATERIALS. Other materials shall be inspected for meeting specified requirements and unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Sod shall be lightly sprinkled with water, covered with moist burlap, straw, or other covering and protected from exposure to wind and direct sunlight until planted. Covering for sod shall allow air to circulate and prevent internal heat from building up. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.4.4 Handling

1.4.4.1 Materials

Care shall be taken to avoid injury to sod. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.4.2 Time Limitation

Sod: Limitation of the time between harvesting and placing of sod shall be 36 hours.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Seed

2.1.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.1.2 Seed Mixtures

Seed mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed
Fine Fescue	Pennlawn	40%	76%
Red Top	N/A	3%	74%
Winter Rye	Aroostock	57%	83%

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2.1.1.3 Quality

Seed shall conform to FS JJJ-S-181. Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.1.1.4 Temporary Seed

The temporary seed for erosion control shall be as follows:

Botanical Name	Common Name	Percent Pure Live Seed
Winter Rye	Aroostock	83%

2.1.1.5 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer.

2.1.2 Sod

2.1.2.1 Sod Classification

State-certified sod shall be provided as classified by applicable state laws. Each individual sod section shall be of a size to permit rolling and lifting without breaking.

2.1.2.2 Grass Species

Grass species shall be proportioned as follows:

Botanical Name	Common Name	Mixture Percent by Weight
Fine Fescue	Pennlawn	40%
Red Top	N/A	3%
Winter Rye	Aroostock	57%

2.1.2.3 Quality

The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 2 inches in any dimension, woody plant roots and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregularly shaped pieces of sod and torn or uneven ends shall be rejected.

2.1.2.4 Thickness

Sod shall be machine cut to a uniform thickness of 1-1/4 inches within a tolerance of 1/4 inch, excluding top growth and thatch. Measurement for thickness shall exclude top growth and thatch.

2.1.2.5 Anchors

Sod anchors shall be as recommended by the sod supplier.

2.1.3 Soil Amendments

Soil amendments shall consist of lime, fertilizer, organic soil amendments and soil conditioners meeting the following requirements.

2.1.3.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

2.1.3.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer: As recommended by the soil test.

2.1.3.3 Organic Soil Amendments

a. Topsoil: The existing surface soil shall be stripped and stockpiled on the site in accordance with Section 02210, GRADING AND SITE RESTORATION. When required beyond that available from stripping, the topsoil shall be delivered. Delivered topsoil shall conform to topsoil requirements specified in Section 02210, GRADING AND SITE RESTORATION, and shall be amended as recommended by soil test.

b. Peat: Peat moss derived from a bog, swampland or marsh shall conform to ASTM D 2607.

c. Sand: Clean, free of toxic materials; 95 percent by weight shall pass a 10-mesh sieve and 10% by weight shall pass a 16-mesh sieve.

d. Rotted Manure: Well rotted, horse or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials, free of stones, sticks, soil and containing no chemicals or ingredients harmful to plants.

e. Decomposed Wood Derivatives: Ground bark, sawdust, or other wood waste material free of stones, sticks, soil, and toxic substances harmful to plants, stabilized with nitrogen and having the following properties:

Particle Size: Minimum percent by weight passing:

Screen Size	Percent
No. 4 mesh Screen	95
No. 8 mesh screen	80

Nitrogen Content: Minimum percent based on dry weight:

Material	Percent
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

f. Calcined Clay: Granular particles produced from montmorillonite clay calcined to minimum temperature of 1200 degrees F to the following gradation: minimum 90 percent passing 8-mesh screen, 99 percent retained on 60-mesh screen and maximum 2 percent passing 100-mesh screen. Bulk density: maximum 40 pounds per cubic foot.

2.1.3.4 Soil Conditioner

Soil conditioner shall be for single use or in combination to meet requirements for topsoil. Gypsum shall be commercially packaged, free flowing, minimum 95 percent calcium sulfate by volume.

2.1.4 Mulch

Mulch shall be free from weeds, mold, and other deleterious materials.

2.1.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.1.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.1.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.1.4.4 Wood Chips

Wood chips shall be chips or shredded bark with maximum particle size of 3/16 inch.

2.1.4.5 Paper Fiber Mulch

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.1.5 Water

Water shall not contain elements toxic to plant life.

2.1.6 Erosion Control Material

Soil erosion control shall conform to the following:

2.1.6.1 Soil Erosion Control Blanket

Machine produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either knitted straw blanket-like mat construction, covered with biodegradable plastic mesh, or interwoven biodegradable thread, plastic netting or twisted kraft paper cord netting.

2.1.6.2 Soil Erosion Control Fabric

Knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

2.1.6.3 Soil Erosion Control Net

Heavy, twisted jute mesh weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.1.6.4 Soil Erosion Control Chemicals

High-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.1.6.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life, without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids must resist mold growth.

2.1.6.6 Anchors

Erosion control anchor material shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 SEEDING AND SODDING TIMES AND CONDITIONS

3.1.1 Seeding Time

Seed shall be sown from April 1 to June 15 for spring planting and from August 16 to November 1 for fall planting.

3.1.2 Sodding Time

Sod shall be placed from April 1 to June 15 for spring planting and from August 16 to November 1 for fall planting.

3.1.3 Turfing Conditions

Turf operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the turf operations, proposed times shall be submitted to and approved by the Contracting Officer.

3.2 SITE PREPARATION

3.2.1 Grading

The Contracting Officer shall verify that finished grades are as indicated on drawings, and the placing of topsoil and the smooth grading has been completed in accordance with Section 02210, GRADING AND SITE RESTORATION.

3.2.2 Application of Soil Amendments

3.2.2.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

3.2.2.2 Lime

Lime shall be applied at the rate recommended by the soil test. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.2.3 Fertilizer

Fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.4 Soil Conditioner

Soil Conditioner shall be spread uniformly over the soil to a minimum depth of 2 inches and thoroughly incorporated by tillage into the soil to a minimum depth of 4 inches.

3.2.3 Tillage

3.2.3.1 Minimum Depth

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required.

3.2.4 Finished Grading

3.2.4.1 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in Section 02210, GRADING AND SITE RESTORATION. Finished grade shall be 1 inch

below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.4.2 Lawn Area Debris

Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

3.2.4.3 Field Area Debris

Field areas shall have debris and stones larger than 3 inches in any dimension removed from the surface.

3.2.4.4 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3 SEEDING

3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.2 Equipment Calibration

The equipment to be used and the methods of turfing shall be subject to the inspection and approval of the Contracting Officer prior to commencement of turfing operations. Immediately prior to the commencement of turfing operations, the Contractor shall conduct turfing equipment calibration tests in the presence of the Contracting Officer.

3.3.3 Applying Seed

3.3.3.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 120 pounds per acre using broadcast seeders. Half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 1/4 inch by straw or hay mulch.

3.3.3.2 Drill Seeding

Seed shall be uniformly drilled to an average depth of 1/2 inch and at the rate of 120 pounds per acre using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder.

3.3.3.3 Rolling

Immediately after seeding, except for slopes 3-horizontal-to-1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.4 Hydroseeding

Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed, fertilizer and water have been thoroughly mixed, to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.5 Mulch

3.3.5.1 Straw or Hay Mulch

Straw or hay mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered. The mulch shall not be bunched. All seeded areas shall be mulched on the same day as the seeding.

3.3.5.2 Mechanically Anchoring

Immediately following spreading, the mulch shall be anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

3.3.5.3 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at rate recommended by manufacturer. Apply with hydraulic equipment suitable for mixing and applying uniform mixture of tackifier.

3.3.5.4 Wood Cellulose Fiber

Wood cellulose fiber mulch for use with the hydraulic application of seed and fertilizer shall be applied as part of the hydroseeding operation.

3.3.6 Water

Watering shall be started within 7 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

3.4 SODDING

3.4.1 General

Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a minimum depth of 1 inch.

3.4.2 Placing Sod

Rows of sod shall be placed parallel to and tightly against each other. Joints shall be staggered laterally. The sod strips shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. On long slopes, sod shall be laid at right angles to slopes. In ditches, sod shall be laid at right angles to the flow of water. When required, the sod shall be anchored by placing anchors a minimum distance of 2 feet on center with a minimum of 2 anchors per sod section.

3.4.3 Finishing

Air pockets shall be eliminated and a true and even surface shall be provided by tamping or rolling the sod in place. Displacement of the sod shall be assured by knitting of sod to the soil. Frayed edges shall be trimmed and holes or missing corners shall be patched in the sod.

3.4.4 Watering Sod

Watering shall be started immediately after completing each day of sodding. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

3.5 EROSION CONTROL

3.5.1 Erosion Control Material

Erosion control material, where indicated or required, shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.5.2 Temporary Turf Cover

3.5.2.1 General

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed as directed by the Contracting Officer.

3.5.2.2 Application

When no other turfing materials have been applied, the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. Seed shall be uniformly broadcast and applied at the rate of 68 pounds per acre. The area shall be watered as required.

3.6 RESTORATION AND CLEAN UP

3.6.1 Restoration

Existing turf areas, pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at Contractor's expense.

3.6.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

3.7 PROTECTION OF TURFED AREAS

Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by the Contracting Officer.

3.8 TURF ESTABLISHMENT PERIOD

3.8.1 Commencement

The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end three (3) months after the last day of turfing operations required by this contract. Written calendar time period shall be furnished to the Contracting Officer for the Turf Establishment Period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

3.8.2 Satisfactory Stand of Turf

3.8.2.1 Seeded Area

a. Lawn Area: A satisfactory stand of turf from the seeding operation for a lawn area is defined as a minimum of 15 grass plants per square foot. Bare spots shall be no larger than 6 inches square. The total bare spots shall not exceed 2 percent of the total seeded area.

b. Field Area: A satisfactory stand of turf from the seeding operation for a field area is defined as a minimum of 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

3.8.2.2 Sodded Area

A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and leaf texture. Bare spots shall be no larger than 2 inches square.

3.8.3 Maintenance During Establishment Period

3.8.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

3.8.3.2 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 1 inch. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.8.3.3 Post-Fertilization

Nitrogen carrier fertilizer shall be applied at the rate determined by soil test after the first month and again prior to the final acceptance. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

3.8.3.4 Repair

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

3.8.3.5 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.9 FINAL ACCEPTANCE

3.9.1 Preliminary Inspection

Prior to the completion of the Turf Establishment Period, a preliminary inspection shall be held by the COR. Time for the inspection shall be established in writing. The acceptability of the turf in accordance with the Turf Establishment Period shall be determined. An unacceptable stand of turf shall be repaired as soon as turving conditions permit.

3.9.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing.

END OF SECTION

SECTION 02935A

HYDROSEEDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Amended thru: Aug 1988) Federal Seed Act Regulations
(Part 201-202)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1990) Agricultural Liming Materials

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 (Basic) Fertilizer

FEDERAL SPECIFICATIONS (FS)

FS JJJ-S-181 (Rev B) Seeds, Agricultural

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.2.1 Delivery

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

1.2.2 Maintenance Report

Written record of maintenance work performed.

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1.2.3 Turf Establishment Period

Written calendar time period for the turf establishment period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

1.2.4 Certificates

Prior to the delivery of materials, certificates of compliance certifying that materials meet the requirements specified. Certified copies of the reports for the following materials shall be included.

1.2.5 Seed

For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

1.2.6 Fertilizer

For chemical analysis, composition percent.

1.2.7 Lime

For calcium carbonate equivalent and sieve analysis.

1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.3.1 Delivery

1.3.1.1 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.3.2 Inspection

Materials will be inspected upon arrival at the job site by the Contracting Officer for conformity to specifications.

1.3.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.3.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Seed Mixtures

Seed mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed
Fine Fescue	Pennlawn	40%	76%
Red Top	N/A	3%	74%
Winter Rye	Aroostock	57%	83%

2.1.3 Quality

Seed shall conform to FS JJJ-S-181. Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.1.4 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer.

2.2 SOIL AMENDMENTS

Soil amendments shall consist of lime, fertilizer, organic soil amendments and soil conditioners meeting the following requirements.

2.2.1 Lime

Lime shall be agricultural limestone in accordance with ASTM C 602 and shall have a minimum calcium carbonate equivalent of 90% percent, Class O.

2.2.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer: As recommended by the soil test.

2.2.3 Organic Soil Amendments

a. Topsoil: The existing surface soil shall be stripped and stockpiled on the site in accordance with Section 02210, GRADING AND SITE RESTORATION. When required beyond that available from stripping, the topsoil shall be delivered. Delivered topsoil shall conform to topsoil requirements specified in Section 02210, GRADING AND SITE RESTORATION, and shall be amended as recommended by soil test.

b. Sand: Clean, free of toxic materials; 95 percent by weight shall pass a 10-mesh sieve and 10 percent by weight shall pass a 16-mesh sieve.

c. Calcined Clay: Granular particles produced from montmorillonite clay calcined to minimum temperature of 1200 degrees F to the following gradation: minimum 90 percent passing 8 mesh screen, 99 percent retained on 60 mesh screen and maximum 2 percent passing 100 mesh screen. Bulk density: maximum 40 pounds per cubic foot.

2.2.4 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.3 WATER

Water shall not contain elements toxic to plant life.

PART 3 EXECUTION

3.1 SEEDING, TIMES AND CONDITIONS

3.1.1 Seeding Time

Seed shall be sown from April 1 to June 15 for spring planting and from August 16 to November 1 for fall plating.

3.1.2 Turfing Conditions

Turf operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the turf operations, proposed times shall be submitted to and approved by the Contracting Officer.

3.2 SITE PREPARATION

3.2.1 Application of Soil Amendments

3.2.1.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

3.2.1.2 Lime

Lime shall be applied at the rate recommended by the soil test. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.1.3 Fertilizer

Fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated as part of the hydroseeding operation.

3.2.1.4 Soil Conditioner

Soil Conditioner shall be spread uniformly over the soil and thoroughly incorporated by tillage into the soil to a minimum depth of 4 inches.

3.2.2 Tillage

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required.

3.2.3 Finished Grading

3.2.3.1 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in Section 02210, GRADING AND SITE RESTORATION. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.3.2 Lawn Area Debris

Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

3.2.3.3 Field Area Debris

Field areas shall have debris and stones larger than 3 inches in any dimension removed from the surface.

3.2.3.4 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3 SEEDING

3.3.1 General

Previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.2 Equipment Calibration

The equipment to be used and the methods of turfing shall be subject to the inspection and approval of the Contracting Officer prior to commencement of turfing operations. Immediately prior to the commencement of turfing operations, the Contractor shall conduct turfing equipment calibration tests in the presence of the Contracting Officer.

3.3.3 Hydroseeding

Seed shall be uniformly spread at the rate of 1,000 gallons per acre. Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed, fertilizer and water have been thoroughly mixed, to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.4 RESTORATION AND CLEAN UP

3.4.1 Restoration

Existing turf areas, pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at Contractor's expense.

3.4.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

3.5 PROTECTION OF TURFED AREAS

Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required.

3.6 TURF ESTABLISHMENT PERIOD

3.6.1 Commencement

The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end three (3) months after the last day of turfing operations required by this contract. Written calendar time period shall be furnished to the Contracting Officer for the Turf Establishment Period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

3.6.2 Satisfactory Stand of Turf

A satisfactory stand of turf from the seeding operation is defined as a minimum of 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

3.6.3 Maintenance During Establishment Period

3.6.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

3.6.3.2 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 1 inch. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.6.3.3 Post-Fertilization

Nitrogen carrier fertilizer shall be applied at the rate of no more than 0.5 pounds per 1000 square feet after the first month and again prior to the final acceptance. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

3.6.3.4 Repair

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

3.6.3.5 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.7 FINAL ACCEPTANCE

3.7.1 Preliminary Inspection

Prior to the completion of the Turf Establishment Period, a preliminary inspection will be held by the Contracting Officer. Time for the inspection will be established in writing. The

acceptability of the turf in accordance with the Turf Establishment Period shall be determined. An unacceptable stand of turf shall be repaired as soon as turfing conditions permit.

3.7.2 Final Inspection

A final inspection will be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection will be established in writing.

END OF SECTION

SECTION 02950A

TREES, SHRUBS, GROUND COVERS, AND VINES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF NURSERYMEN (AAN)

AAN-01 (1990) American Standard for Nursery Stock

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.2.1 Plants

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Reports for the following materials shall be included.

Plant Materials: For botanical and common name, size, quantity by species, grade, nursery grown.

1.2.2 Maintenance Instructions

Written instructions for year-round care of installed plants.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Varieties

Plants shall be nursery grown stock conforming to AAN-01 and shall be of the varieties specified in the plant list bearing botanical names listed in one or more of the publications listed under "Nomenclature" in AAN-01.

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2.1.2 Substitutions

Substitutions will not be permitted without written approval by the Contracting Officer.

2.1.3 Quality

Well shaped, well grown, vigorous, healthy plants having healthy and well branched root systems shall be provided. Plants shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plants shall be provided that are typical of the species or variety and conforming to standards as set forth in AAN-01 and as specified herein.

2.1.4 Size

Plants shall be furnished in sizes indicated. Plants larger in size than specified may be provided at no additional cost to the Government. Plant measurement shall be in accordance with AAN-01.

2.2 SOIL AMENDMENTS

The Contractor shall provide soil amendments as required by the attached soil tests. Soil amendments shall include fertilizer, lime, peat, or any other materials required by the soil tests.

2.3 MULCH

Mulch materials shall be ground or shredded bark and shall be free from weeds, mold and other deleterious materials.

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted by the Contracting Officer to meet field conditions.

3.1.2 Underground Obstructions to Planting

The location of underground utilities and facilities shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.1.3 Turf Removal

Where planting beds occur in existing turf areas, the turf shall be removed to a depth that will ensure the removal of the entire root system.

3.2 PLANTING TIMES AND CONDITIONS

Planting shall be done when the ground is not frozen, snow-covered, or in an otherwise unsuitable condition for planting.

3.2.1 Deciduous Planting Time

Deciduous plants shall be installed from April 1 to November 1.

3.2.2 Evergreen Planting Time

Evergreen plants shall be installed from April 1 to November 1.

3.3 INSTALLATION

Plants shall be set plumb and in position until sufficient soil has been firmly placed around roots or ball. Plants shall be set in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery or in the container. Staking and guying shall be provided as required.

3.4 FINISHING

3.4.1 Plant Beds

Planted areas shall be uniformly edged to provide a clear-cut division line between the planted area and the adjacent turf area and to provide a shape as indicated. The entire planted area shall be raked and smoothed while maintaining the earth saucers.

3.4.2 Mulch

Mulch shall be spread to a uniform thickness of 4 inches within 48 hours after planting. Mulch shall be kept out of the crowns of shrubs and off buildings, sidewalks and other facilities.

3.5 MAINTENANCE DURING PLANTING OPERATION

Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the plant establishment period commences. The maintenance includes fertilizing, wrapping,

staking, watering, pruning, applying wound dressing, straightening and other necessary operations. Plant beds and earth saucers shall be kept free of weeds, grass and other undesired vegetation. Plants shall be checked for settlement and shall be reset to proper grade as necessary. Run-off, puddling and wilting shall be prevented.

3.6 CLEAN UP

Excess and waste material from the planting operation shall be removed and disposed of off the site. Adjacent paved areas shall be cleaned.

3.7 PLANT ESTABLISHMENT PERIOD

3.7.1 Commencement

The plant establishment period shall commence when the planting operation is completed and shall be in effect for a period of 12 months.

3.7.2 Maintenance During Establishment Period

Maintenance of plants shall be as described in paragraph MAINTENANCE DURING PLANTING OPERATION.

3.7.3 Unhealthy Plants

A plant shall be considered unhealthy when the main leader has died back, or 25 percent of the crown is dead. The cause for an unhealthy plant shall be determined. Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.8 ACCEPTANCE

An inspection will be held 12 months from the date of the beginning of the plant establishment period to determine plant acceptability and the number of replacements. Plants not in healthy growing condition will be noted and as soon as seasonal conditions permit shall be removed from the site and replaced with plants of the same species and sizes as originally specified. Alternate or substituted varieties of plants shall be used only as approved.

END OF SECTION

SECTION 03101

FORMWORK FOR CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 347R (1988) Guide to Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31 (1990a) Making and Curing Concrete Test Specimens in the Field

ASTM C 39 (1986) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 1074 (1987) Estimating Concrete Strength by the Maturity Method

ASTM C 1077 (1991a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1983) Construction and Industrial Plywood

1.2 DESIGN REQUIREMENTS

The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. However, for surfaces with an ACI Class A surface designation, the allowable deflection for facing material between studs, for studs between walers and walers between bracing shall be limited to 0.0025 times the span. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators,

retarders, air entrainment, and others. The adequacy of formwork design and construction shall be monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.3.1 Materials

Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, form coating and form-lining materials.

1.3.2 Shop Drawings

Drawings and design computations for all formwork required shall be submitted at least 30 days either before fabrication on site or before delivery of prefabricated forms.

If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.

1.3.3 Inspection

The Contractor shall submit field inspection reports for concrete forms and embedded items.

1.3.4 Formwork Not Supporting Weight of Concrete

If forms are to be removed in less than 24 hours on formwork not supporting weight of concrete, the evaluation and results of the control cylinder tests shall be submitted to and approved by the Contracting Officer before the forms are removed.

1.4 SHOP DRAWINGS

The drawings and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Forms and Form Liners

Forms and form liners shall be fabricated with facing materials that will produce a finish meeting the specified construction tolerance requirements and the following surface classifications as defined in ACI 347R.

2.1.1.1 Class "A" Finish

This class of finish shall apply to all exposed surfaces. The form facing material shall be composed of new, well-matched-tongue-and-groove lumber or new plywood panels conforming to DOC PS 1, Grade B-B concrete form, Class I.

2.1.1.2 Class "B" Finish

This class of finish shall apply to all surfaces except those specified to receive Class A. The form facing material shall be composed of tongue-and-groove or shiplap lumber, plywood conforming to DOC PS 1, Grade B-B concrete form, tempered concrete form hard board or steel. Steel lining on wood sheathing will not be permitted.

2.1.2 Form Coating

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, the Contractor shall follow the recommendation of the form coating manufacturer.

2.2 ACCESSORIES

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Form Construction

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. The Contractor shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class specified in paragraph "FORMS AND FORM LINERS" and tolerances specified in paragraph "DESIGN REQUIREMENTS". Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

3.1.2 Chamfering

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated twelve inches outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.1.3 Coating

Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.2 FORM REMOVAL

Forms shall not be removed without approval of the Contracting Officer. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum time, minimum ambient temperature, and minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed as required. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31 and ASTM C 39 at the expense of the Contractor by an independent laboratory that complies with ASTM C 1077 and shall be tested within 4 hours after removal from the site.

3.2.1 Formwork Not Supporting Weight of Concrete

Formwork for walls, columns, sides of beams, gravity structures, and other vertical type forms not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed.

3.2.2 Formwork Supporting Weight of Concrete

Supporting forms and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders indicate evidence the concrete has attained at least 90% of the compressive strength required for the structure.

3.3 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

END OF SECTION

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SECTION 03250

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1982; R 1988) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1751 (1983) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2628 (1981) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D 2835 (1989) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 513 (1974) Rubber Waterstops

COE CRD-C 572 (1974) Polyvinylchloride Waterstops

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200 (Rev E; Am 1) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

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FS SS-S-1401 (Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

FS SS-S-1614 (Rev A; Notice 1) Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.2.1 Materials

Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

1.2.2 Certificates

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION-JOINT STRIPS

Contraction-joint strips shall be 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 EXPANSION-JOINT FILLER

Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 1/2-inch thick and of a width applicable for the joint formed.

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2.3 JOINT SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Joint Seals

ASTM D 2628.

2.3.2 Lubricant for Installation of Preformed Compression Seals

ASTM D 2835.

2.3.3 Hot-Poured Type

FS SS-S-1401.

2.4 WATERSTOPS

Waterstops shall conform to COE CRD-C 513 or COE CRD-C 572.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC insert strips into the plastic concrete or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8-inch wide and shall extend into the slab approximately one-fourth the slab thickness but not less than 1 inch.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of the strips is maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete-sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Premolded expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Types and locations of sealants shall be as indicated. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant. Joints sealed with field molded sealant shall be completely filled with sealant.

3.2 WATERSTOPS

Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Splices shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.

END OF SECTION

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SECTION 03300A

CONCRETE FOR BUILDING CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318 (1989; 318R-89) Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615 (1990) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 94 (1990) Ready-Mixed Concrete

ASTM C 309 (1989) Liquid Membrane-Forming Compounds for Curing Concrete

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.2.1 Cementitious Materials

Cement, pozzolan, and ground iron blast-furnace slag will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished. No cement, pozzolan, or slag shall be used until notice of acceptance has been given by the Contracting Officer. Cement, pozzolan, and slag may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site.

1.2.2 Perimeter Insulation

Certificate attesting that the polyurethane insulation furnished for the project contains recovered material, and showing an estimated percentage of such recovered material.

1.2.3 Proportions of Mix

The results of trial mix along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory.

1.2.4 Sampling and Testing

Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials.

1.3 GENERAL REQUIREMENTS

1.3.1 Strength Requirements

Structural concrete for all work shall have a 28-day compressive strength of 3000 pounds per square inch. Concrete slabs on-grade as indicated shall have a 28-day flexural strength of 600 pounds per square inch. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement.

1.3.2 Air Entrainment

All concrete shall contain from 4 to 7 percent total air.

1.3.3 Special Properties

Concrete may contain other admixtures, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if approved.

1.3.4 Slump

Slump shall be within the following limits:

Structural Element	*Slump in inches	
	Minimum	Maximum
Walls, columns and beams	2	4
Foundation walls, substructure walls, footings, pavement, and slabs	1	3
Any structural concrete approved for placement by pumping	None	6

*Where use of superplasticizers are approved to produce flowing concrete these slump requirements do not apply.

PART 2 PRODUCTS

2.1 CONCRETE INGREDIENTS

Concrete shall conform to ASTM C 94; type 1.

2.2 CURING MATERIALS

Curing materials shall be burlap, impervious sheets, or membrane-forming compounds.

2.3 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel.

2.4 FORM MATERIALS

Forms for concrete surfaces shall be metal, plywood, or hardboard capable of producing the required surface without adverse effect on the concrete. Form coating shall be nonstaining form oil or form release agent that will not adversely affect the concrete surfaces or impair subsequent applications to the concrete. Form ties shall be metal, factory-fabricated, removable or snap-off type that will not leave holes less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter.

2.5 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of fifty-five percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogenous material sufficiently porous to provide a good bond with portland paste; or factory-graded emery material consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The material shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.6 PERIMETER INSULATION

Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Perimeter insulation shall be polystyrene, polyurethane containing a minimum of 9 percent recovered material in the polyurethane portion or cellular glass; thickness as shown.

2.7 REINFORCEMENT

Bar reinforcement shall be deformed, Grade 40 or Grade 60 billet steel conforming to ASTM A 615. Mesh reinforcement shall be welded steel wire fabric with wires at right angles to each other.

2.8 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms.

2.9 WATER

Water shall be potable.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance. Surfaces shall be moist but without free water when the concrete is placed.

3.2 FORMWORK

Formwork shall be mortar-tight, properly aligned, and adequately supported to produce concrete conforming accurately to the indicated shapes, lines, dimensions, and with surfaces free of offsets, waviness, or bulges. Where surfaces are to be exposed or painted, panels shall be of uniform sizes, using smaller panels only where required by openings, joints or for closure. Unless otherwise shown, exposed external corners shall be chamfered, beveled or rounded by moldings placed in the forms. Form surfaces shall be thoroughly cleaned and coated before each use. Forms shall be removed at a time and in a manner that will not injure the concrete.

3.3 INSTALLATION OF REINFORCEMENT

Reinforcement shall be fabricated to the required shapes. Reinforcement shall be interrupted 2 inches on each side of expansion joints. Reinforcement shall be accurately positioned and secured in place.

3.4 INSTALLATION OF PERIMETER INSULATION

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundations walls.

3.5 INSTALLATION OF VAPOR BARRIER

Unless otherwise indicated, subgrades for slabs in buildings shall be covered with a vapor barrier. Vapor barrier edges shall be lapped at least 4 inches and ends shall be lapped not less than 6 inches. Patches and lapped joints shall be sealed with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane.

3.6 INSTALLATION OF EMBEDDED ITEMS

Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

3.7 BATCHING, MIXING AND TRANSPORTING CONCRETE

The work shall conform to ACI 318 part Construction Requirements, except as otherwise specified.

3.8 CONCRETE PLACEMENT

Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 8 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

3.9 CONSOLIDATION

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

3.10 WEATHER LIMITATIONS

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The temperature of the concrete placed during warm weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

3.11 CONSTRUCTION JOINTS

Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval by the Contracting Officer.

3.12 FINISHING CONCRETE

3.12.1 Formed Surfaces

Fins and loose material shall be removed. Unsound concrete, voids over 1/2 inch in diameter, and tie-rod bolt holes shall be cut back to solid concrete, reamed, brush-coated with cement grout, and filled solid with a stiff portland cement and sand mortar mix. Patchwork shall finish flush with adjoining concrete surfaces in texture and color. Patchwork shall be cured for 72 hours.

3.12.2 Unformed Surfaces

3.12.2.1 Rough-Slab Finish

Slabs to receive fill or mortar setting beds shall be screeded with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.

3.12.2.2 Float Finish

Slabs, where indicated, shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Lightweight concrete or concrete that portrays stickiness shall be finished with a magnesium float in lieu of a wood float, and left free of ridges and other projections.

3.12.2.3 Trowel Finish

Slabs, where indicated shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer.

3.12.2.4 Broom Finish

After floating, slabs, where indicated shall be lightly trowelled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

3.13 CURING AND PROTECTION

3.13.1 General

Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period.

3.13.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap or saturated burlap.

3.13.3 Membrane Curing

Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete; except a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. On

surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

END OF SECTION

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SECTION 04200

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI SP-66 (1988) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1990a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153 (1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615 (1990) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 55 (1985) Concrete Building Brick

ASTM C 62 (1991b) Building Brick (Solid Masonry Units Made from Clay or Shale)

ASTM C 67 (1991) Sampling and Testing Brick and Structural Clay Tile

ASTM C 90 (1990) Load-Bearing Concrete Masonry Units

ASTM C 91 (1991) Masonry Cement

ASTM C 129 (1985; R 1990) Non-Load-Bearing Concrete Masonry Units

ASTM C 140 (1991) Sampling and Testing Concrete Masonry Units

ASTM C 216 (1991c) Facing Brick (Solid Masonry Units Made from Clay or Shale)

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ASTM C 270	(1992) Mortar for Unit Masonry
ASTM C 476	(1991) Grout for Masonry
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 578	(1992) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 641	(1982; R 1991) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(1991c) Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C 744	(1973; R 1985) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(1991) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(1989a) Sampling and Testing Grout
ASTM C 1072	(1986) Measurement of Masonry Flexural Bond Strength
ASTM D 2000	(1990) Rubber Products in Automotive Applications
ASTM D 2240	(1991) Rubber Property - Durometer Hardness
ASTM D 2287	(1981; R 1988) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(1988) Fire Tests of Building Construction and Materials
ASTM E 447	(1992) Compressive Strength of Masonry Prisms

FEDERAL SPECIFICATIONS (FS)

FS HH-I-1972/1	(Basic; Notice 1) Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced With Aluminum Foil on Both Sides of the Foam
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1.2 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.2.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.2.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.2.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Type I, Grade S-II. Concrete brick may be used where necessary for filling out in concrete-masonry unit construction.

2.3 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, normal weight. Cement shall have a low alkali content and be of one brand.

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2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be one inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4 PRECAST CONCRETE ITEMS

Trim, lintels, copings, splashblocks and door sills, shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section 03300A, CONCRETE FOR BUILDING CONSTRUCTION using 1/2-inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 pounds per square inch for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.4.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure.

2.4.2 Splash Blocks

Splash blocks shall be as indicated. Reinforcement shall be the manufacturer's standard.

2.5 MORTAR

Mortar shall be Type S in accordance with the proportion specifications of ASTM C 270 except as modified below. Masonry cement, in accordance with ASTM C 91, may be used when the maximum air content is limited to 12 percent and it can be verified that it will provide performance equal to the portland cement-lime mortar. Evaluation of performance shall be based on ASTM C 780 and ASTM C 1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the No. 8 sieve and 95 percent passing the No. 16 sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.5.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, contain less than 0.2 percent chlorides, and conform to ASTM C 494, Type C.

2.6 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table II.

2.6.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, contain less than 0.2 percent chlorides, and conform to ASTM C 494, Type C.

2.6.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.7 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.8 JOINT REINFORCEMENT

Joint reinforcement shall be factory-fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153, class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall provide a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory-formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.9 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920A, CAULKING AND SEALANTS.

2.10 FLASHING

Flashing shall be as specified in Section 07600A, SHEET METALWORK, GENERAL.

2.11 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 3/8-inch mortar joint.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

3.1.2.2 Air Temperature 40 Degrees F to 32 Degrees F

Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.

3.1.2.3 Air Temperature 32 Degrees F to 25 Degrees F

Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

3.1.2.4 Air Temperature 25 Degrees F to 20 Degrees F

Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

3.1.2.5 Air Temperature 20 Degrees F and Below

Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.6 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.
- b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.
- d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2-inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be free from chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2-inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8-inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. In no case shall supporting forms or shores be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than one gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.1 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.2 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II
TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises

In adjacent masonry units	1/8-inch
In 10 feet	1/4-inch
In 20 feet	3/8-inch
In 40 feet or more	1/2-inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines

In 20 feet	1/4-inch
In 40 feet or more	1/2-inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines

In 20 feet	1/4-inch
In 40 feet or more	1/2-inch

Variation from level for bed joints and top surfaces of bearing walls

In 10 feet	1/4-inch
In 40 feet or more	1/2-inch

Variations from horizontal lines

In 10 feet	1/4-inch
In 20 feet	3/8-inch
In 40 feet or more	1/2-inch

Variations in cross sectional dimensions of columns and in thickness of walls

Minus	1/4-inch
Plus	1/2-inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8-inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8-inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8-inch joints, except for prefaced concrete masonry units.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.3 WEEP HOLES

Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.4 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.5 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8-inch cover to either face of the unit.

3.6 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.6.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.6.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.6.3 Grout Holes and Cleanouts

3.6.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3- by 4-inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.6.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3- by 4-inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.6.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.6.4 Grouting Equipment

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are

required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.8 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. All shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 10 feet and installed with a 1/4-inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

3.9 LINTELS

3.9.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2-inch above the bottom inside surface of the lintel unit.

3.9.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.10 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.11 PARGING

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 1/2-inch thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 6 inches below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.12 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.13 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, all defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.13.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.14 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300A, CONCRETE FOR BUILDING CONSTRUCTION.

3.15 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

END OF SECTION

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SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- | | |
|-----------|---|
| AISC-02 | (1989) Manual of Steel Construction Allowable Stress Design |
| AISC S329 | (1986) Allowable Stress Design Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts |
| AISC S335 | (1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|------------|---|
| ASTM A 6 | (1990a) Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use |
| ASTM A 36 | (1991) Structural Steel |
| ASTM A 53 | (1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| ASTM A 307 | (1991) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A 325 | (1991c) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| ASTM A 500 | (1990a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A 529 | (1989) Structural Steel with 42 ksi (290 MPa) Minimum Yield Point (1/2 in. (13 mm) Maximum Thickness) |

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ASTM A 563 (1991c) Carbon and Alloy Steel Nuts
ASTM F 436 (1991) Hardened Steel Washers
ASTM F 844 (1990) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1 (1985) Surface Texture (Surface Roughness, Waviness and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1986) Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1 (1992) Structural Welding Code - Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members.

Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with AISC-02. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC S335 shall govern the work. Welding shall be in accordance with AWS D1.1. High-strength bolting shall be in accordance with AISC S329.

1.3 SUBMITTALS

SD-13 Certificates

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Welder Qualifications

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade B.

2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Type E, Grade B.

2.4 CARBON STEEL BOLTS

Carbon steel bolts shall conform to ASTM A 307, Grade A.

2.5 CARBON STEEL NUTS

Carbon steel nuts shall conform to ASTM A 563, Grade A, Style.

2.6 WASHERS

Plain washers shall conform to ASTM F 844.

2.7 PAINT

Paint shall conform to SSPC Paint 25.

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PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of the AISC S335. Structural steelwork, except surfaces of steel to be encased in concrete and surfaces to be field welded, shall be prepared for painting in accordance with the AISC S335 and primed with the specified paint.

3.2 ERECTION

Erection of structural steel shall be in accordance with the applicable provisions of the AISC S335.

3.2.1 Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work.

3.2.2 Bearing Plates

Bearing plates for beams and similar members shall be provided. Bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate shall be damp-packed solidly with nonshrink grout. Grout shall be as specified in Section 03300A, CONCRETE FOR BUILDING CONSTRUCTION.

3.2.3 Field Welded Connections

Field welded structural connections shall be completed before load is applied.

3.2.4 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

END OF SECTION

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SECTION 05500

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

- | | |
|-----------|--|
| AA DAF-45 | (1980) Designation System for Aluminum Finishes |
| AA SAA-46 | (1978) Standards for Anodized Architectural Aluminum |

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|------------|--|
| ANSI A14.3 | (1984) Ladders - Fixed - Safety Requirements |
|------------|--|

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|------------|--|
| ASTM A 36 | (1991) Structural Steel |
| ASTM A 53 | (1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| ASTM A 123 | (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 283 | (1991) Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASTM A 446 | (1991) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality |
| ASTM A 500 | (1990a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A 525 | (1991b) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process |

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- ASTM B 26 (1992a) Aluminum-Alloy Sand Castings
- ASTM B 221 (1992a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- ASTM B 429 (1992a) Aluminum-Alloy Extruded Structural Pipe and Tube

AMERICAN WELDING SOCIETY (AWS)

- AWS D1.1 (1992) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

- NAAMM-01 (1988) Metal Finishes Manual for Architectural and Metal Products

1.2 SUBMITTALS

SD-04 Drawings

Miscellaneous Metal Items

Drawings for exterior sloping basement door shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 446, or ASTM A 525, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

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1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

PART 2 PRODUCTS

2.1 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have standard mill finish.

2.2 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

2.3 FOUNDATION VENTS

Foundation vents shall be the same size as the masonry units or size as indicated, and shall be of extruded aluminum with integral water stop and sliding interior closer or

damper operable from the outside. Insect screen shall be provided at the back of the vent. Louvered opening shall have top and bottom drip lips, and the net ventilating area with closer or damper open shall be at least 35 percent of the gross wall opening. The frames shall have a structural strength adequate to permit use in masonry walls without a lintel.

2.4 HANDRAILS

Handrails shall be designed to resist a concentrated load of 200 pounds in any direction at any point of the top of the rail or 20 pounds per foot applied horizontally to top of the rail, whichever is more severe.

2.4.1 Aluminum Handrails

Handrails shall consist of 1-3/4-inch square aluminum semi-hollow tube with rounded corners ASTM B 221. Railings shall be mill finish aluminum color. All fasteners shall be Series 300 stainless steel.

a. Fabrication: Jointing shall be by one of the following methods:

(1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8-inch recessed head setscrews.

(2) Mitered and welded joints, made by fitting post to top rail and intermediate rail to post and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Dowel or sleeve shall be connected to one side of the splice by tack welding or by using epoxy cement.

(3) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4-inch or 3/8-inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B 26.

b. Removable Railing Sections: Removable railing sections shall be as indicated. Toe-boards and brackets shall be provided where indicated, using flange castings as appropriate.

2.4.2 Basement Door

Basement door assembly as shown on drawing shall be fabricated of steel not less than 13 gauge, thickness. Basement door shall be furnished complete with all hardware

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assembly bolts and anchors for securing to masonry. Minimum 14 gauge galvanized steel stringer to hold stair treads as shown on drawing is to be supplied by basement door fabricator (complete with fasteners to secure to masonry). Basement door shall have flowcoated and baked on factory prime finish.

2.5 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.2.1 Installation of Aluminum Handrails

Installation shall be as indicated on the drawings. Bolts used to anchor aluminum alloy flanges shall be stainless steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphalt varnish.

END OF SECTION